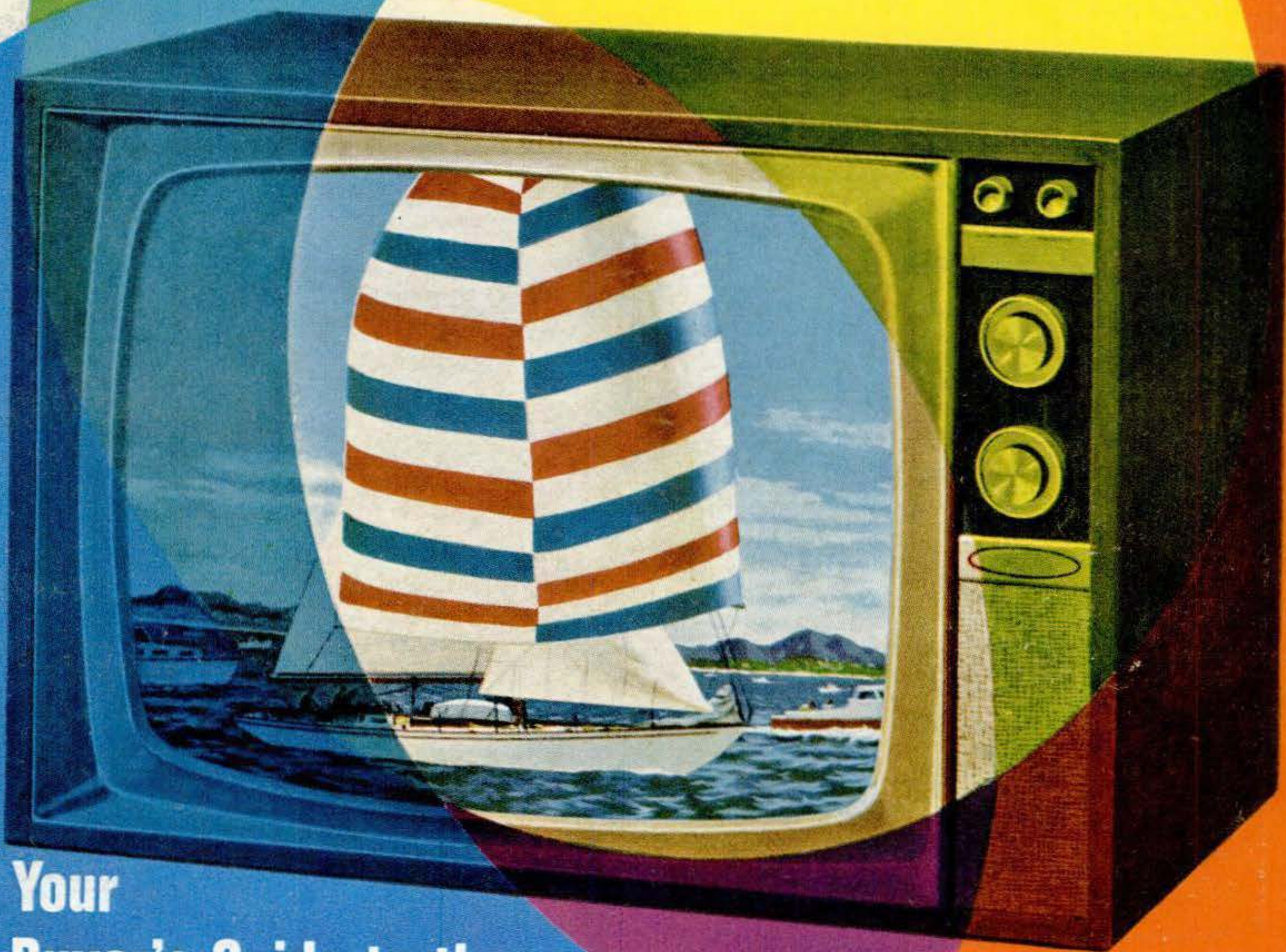
FEBRUARY 1968 35 CENTS

Popular Science

MONTHLY

How to Tune Your Motorcycle Engine



Your Buyer's Guide to the TOP 10 COLOR TVs

BOATS • BOATS • BOATS

- News from the Boat Shows
- Power or Sail?
- Rules-of-the-Road Reminder
- 26 Ways to Have Fun Afloat

New Batteries That Pack More Power

Test Report on the Mustang, Camaro, Barracuda, Javelin

New PS Stereo Test Record

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The Chrysler Crew has more that's new!
23-foot cabin cruiser and 15-foot utility runabout!

Here they come! A brilliant new cabin cruiser and a new center-console runabout! Both Hydro-Vee's—Chrysler's new patented fiberglass hull design that combines hydroplane performance with deep-vee stability.

The Commando 151 with 151-cubic-foot capacity is a boat that goes all ways—and safely, thanks to Foam-Pac, Chrysler's new exclusive flotation.

The Commodore 486 features cabin berths, marine toilet and stove in a 486-cubic-foot hull, beautifully textured vinyls, fabrics and panelling. Your Chrysler Crew dealer has seven Hydro-Vee's from 14 to 23 feet, seven fiberglass flyers, four aluminum beauties, three swift sailers and a lakeful of new fishing boats! All in a new choice of dazzling colors!

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Find another car under $2,000 that has all that the Renault 10 has, and we'll buy it for you.

We believe the Renault 10 gives you more for your money than any other car.

And the fact that sales have soared since we introduced it, leads us to believe that quite a few people agree. We sold 72% more 1967 Renaults than 1966 Renaults.

But if some doubters remain, we offer this challenge:

Find another car under $2,000 that has all that the Renault 10 has, and we'll buy it for you.

The Renault 10 has, as standard equipment:

4-wheel disc brakes

Disc brakes take hard braking better than drum brakes. They have long been used on super-speed, super-priced automobiles.

4 doors instead of 2

You don't have to fight the front seat to get to the back seat.

35 miles per gallon

Some people say they get more.

Contoured seats that recline for sleeping

Plus 18 other positions for when you're not sleeping.

Engine weight over the drive wheels

The drive wheels bear down on snow and ice because the engine weight bears down on them.

Turning circle of 30 feet

You can make most u-turns in one clean sweep.

4-wheel independent suspension

Each wheel moves up or down without affecting all the other wheels. So when one wheel hits a bump, only one gets bumped. The other 3 keep the car and you going in a level position.

4-speed synchromesh transmission

This matches the speeds of the engine and transmission to allow the gears to mesh easily. Which makes shifting a lot easier on you and your transmission.

Replaceable wet cylinder sleeves

When the cylinders wear out in a conventional engine, the whole engine has to be pulled out and rebored. Sometimes it pays to buy a new car. But a Renault piston moves in a replaceable wet sleeve. If the sleeve ever wears out, you can put in a new one easily and inexpensively.

Sealed liquid cooling system with expansion tank

Water-cooled engines are much quieter than air-cooled engines. However, water and anti-freeze can frequently overflow. But Renault's water-cooling system has an expansion tank to keep the overflow from escaping.

5 main-bearing engine

Instead of three bearings supporting the crankshaft, we have five. (As many as most V-8's.)

Special vents for draft-free ventilation

You can get plenty of fresh air with the windows shut. Which, incidentally, shuts out noise.

Rack and pinion steering

Eliminates play in the steering.

2-speed hot-water heater and dual defroster

Our heater uses the same hot water that circulates in the engine. So our heater heats faster and produces a more even temperature than any air-type heater.

15 inch wheel

Most economy cars have 13" or less. Our larger wheel makes fewer revolutions to go the same distance. Which saves rubber. Which saves money.

Spare tire not in trunk

If you get a flat you don't have to unload the trunk and get everything dirty.

11 cubic foot trunk capacity

We're not the biggest in this department, but neither are we the smallest. The smallest only has 2.3 cubic feet, which is about as much space as we have behind our back seat alone.

Hits a top speed of 85

That's pretty surprising considing the mileage we get.

Unique warranty

12 months/unlimited mileage.

Price—Under $2,000

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Your Buyer's Guide to the Top 10 Color TVs PAGE 73

Going dizzy selecting a color set? Relax. Here are the results of the most extensive color-TV viewing tests ever conducted by a magazine.

Who Makes the Best Sporty Compact? PAGE 82

Norbye/Dunne Report: All about the Mustang, Camaro, Barracuda, Javelin.

VON BRAUN: "Inner Space" Rehearsals for Outer Space PAGE 106

Dr. Wernher von Braun tells how astronauts train—under water—for space tasks.

How to Tune Your Motorcycle Engine PAGE 112

Everything you need to know for fast starts, quick getaway, and less huff-huff on hills.

Special PS Boating Section PAGE 162

Couldn't get to the Boat Show? Hung up over sail or power? Missing out on the last bit of fun from your boat? You'll find it all here! See pages 162-179.

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COMING NEXT MONTH

In March PS, you'll find articles that run the gamut of lively reading from A to Z—adventurous to zany: Jacques Piccard, the noted underwater pioneer, tells you how he'll explore the Gulf Stream in the PX-15, a sub built to drift silently in the ocean's depths . . . and you'll get a look at Dick Van Dyke's crazy vehicle—the Chitty Chitty Bang Bang—that can't decide whether it's a car, a hovercraft, or a helicopter . . . Smokey Yunick gives you the lowdown on how to get started in racing . . . Our car-testing team, Norbye and Dunne, come up with their revealing monthly report—this time the Dart, Falcon, and Chevy II . . . Mario Andretti drives the sporty new AMX . . . You'll learn how to build the totally new Superchair, all from two-by-twos (with blueprint) . . . and all about an amazing new kind of wood with built-in finish . . . Richard Day advises you what *not* to look for in a used car . . . Plus news on space, aviation, boating, photography, electronics, tools . . . and more.

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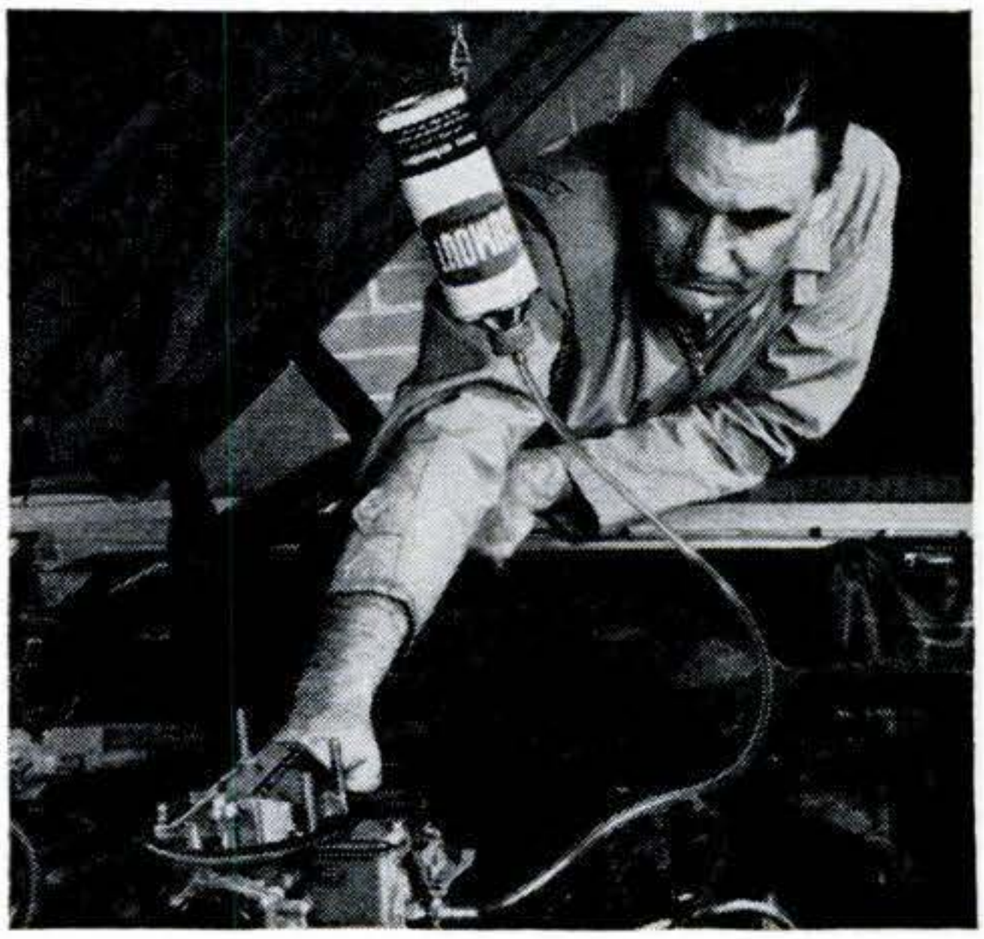
Fast Way to Clean Your Carburetor Right on the Engine



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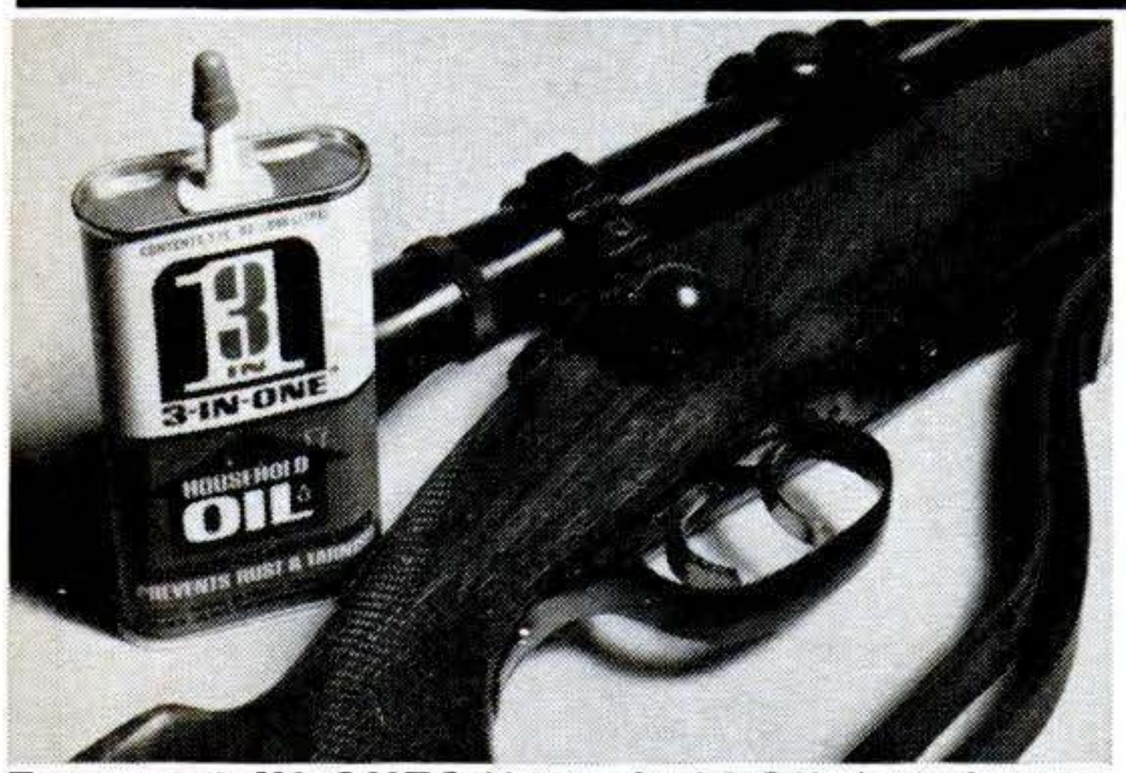

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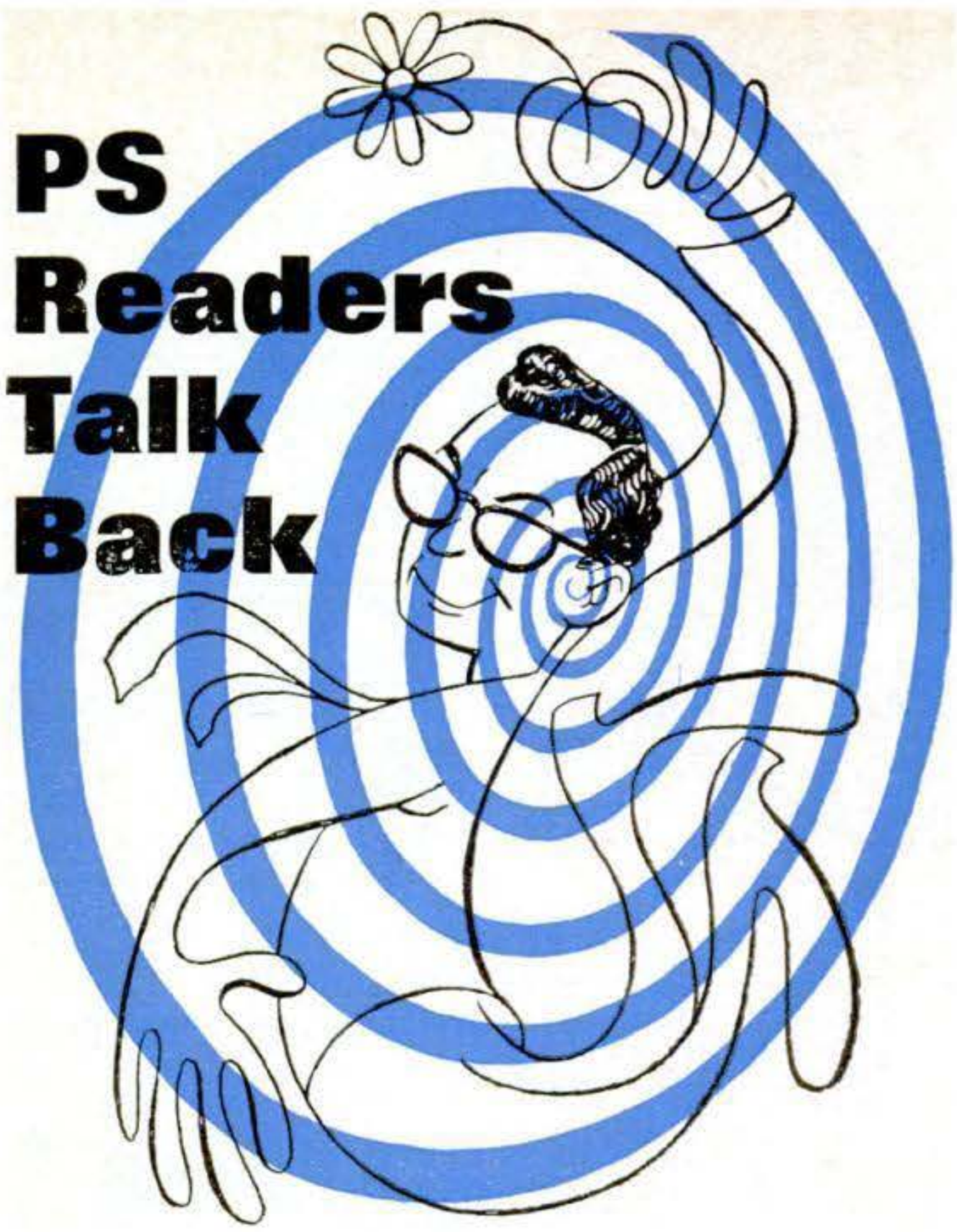

Travel notes about LSD trip

Robert Gannon, a gifted writer, wrote of his experiences with LSD in "My LSD Trip" [Dec.] so realistically that the reader feels that he also is taking the trip. But Gannon omitted one very important detail: Would he take the trip again, not just for the purpose of getting material to write about?

E. P. ALDREDGE, Dallas, Tex.

Reporter Gannon says "no."

. . . I am sorry not to continue getting PS anymore, but my conscience won't allow it after reading "My LSD Trip," in which flower people are called "simple and idealistic" and the supposedly scientific conclusions sound exactly like the radicals who say that its danger is exaggerated.

MARGARET GEFFERSON, Sarasota, Fla.

. . . Give Robert Gannon a hearty pat on the back for his LSD trip report. I was tremendously impressed by one of the very few honest-to-goodness reports on the most important drug of our time.

WILLIAM LEVY, Woodside, N.Y.

Tips on winter camping

Your article, "Snowmobiles Start a New Camping Craze," [Dec.] has a lot of useful information for outdoorsmen. But I'd like to add a few comments about safety. If your snowmobile is disabled, disconnect the drive belt and you can pull it easily on its own track. If you are alone and the snow is soft, wait until late in the day when the snowmobile track freezes. Then you'll be able to walk out easily on the hard compact snow. When you tow a toboggan, make sure you get one with a fixed tongue, otherwise it will turn over and dump your gear when you're going around a turn. Lastly, besides wearing warm clothing, make sure that it's waterproof, because you slide around quite a bit on the seat and your bottom can get awfully wet. Your boots, or at least their bottoms, should also be made of rubber to keep your feet dry.

JOHN W. HETHRINGTON,
Marketing Manager, Bombardier Ltd.,
Valcourt, Quebec.

Cleaning up the mystery of teeth

I was very pleased with Lawrence Galton's article "Your Teeth Can Last a Lifetime" [Nov.]. I would wager that the information on those few pages will do more for dental-health education than all the professional information written in a year.

BRODIE G. SECREST Jr., DDS,
Cambridge, Ohio.

Old-fashioned skiing

"Short-EE Skis" [Dec.] by Walter Ian Fischmann evoked reminiscences of pleasant experiences years ago. Actually Clif Taylor did not invent short skis. We rode them down hills and river banks in Wisconsin almost 50 years ago—before Mr. Taylor had strapped on a ski. But I agree they can be a short cut to winter fun. Northland's Short-EE skis are more sophisticated than the ones we had. Ours were made of

barrel staves, trimmed down and then sandpapered and polished. We cut grooves in the convex sides to form runners and then waxed them.

J. HARTT WALSH, Indianapolis.

They must have been a barrel of fun.

. . . The Short-EE skis article takes the cake. I understand that Americans seem to hold a monopoly on lack of self-sufficiency. Anyone who would panic on a child's ski slope must be neurotic. We Canadians are

Continued

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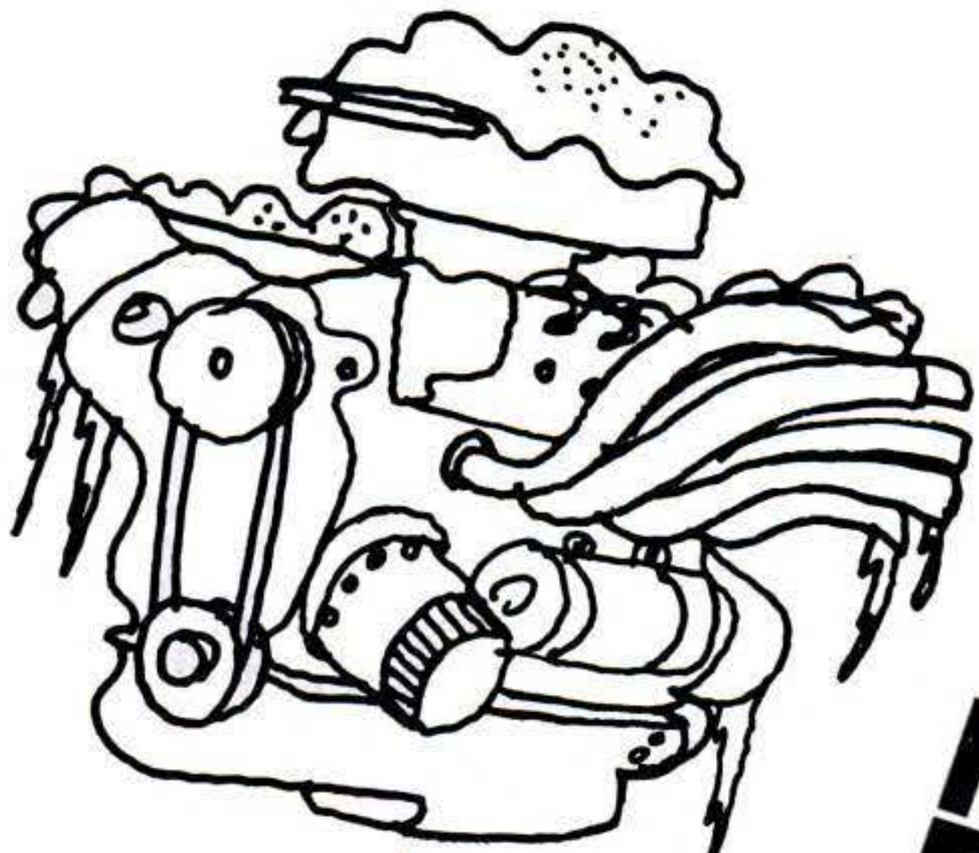

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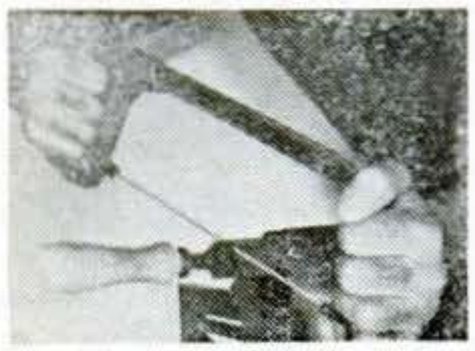

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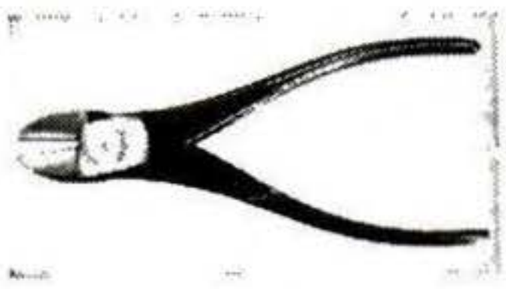

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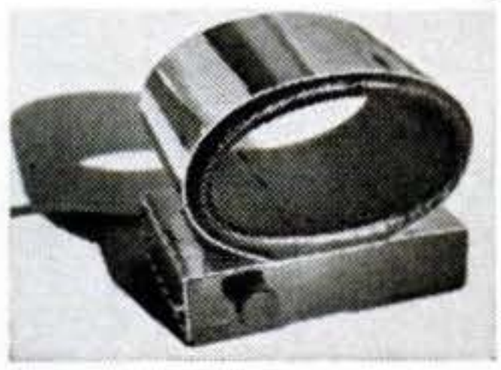

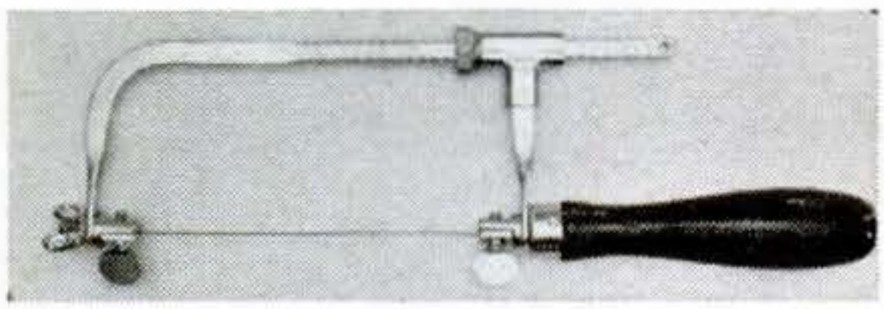

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PS Readers Talk Back

[*Continued*]

not afraid to learn to ski. We don't spend weeks learning how to stand and don't need instructors. We can learn by ourselves. Perhaps we are a little more self-sufficient than our good neighbors to the south, or is it just that Americans consider it class not to be able to do anything for themselves?

LEE TREMBLAY, Vaudreuil, Quebec.

Switch on boat power

In your diagram showing how a ship's-generator system delivers 30 amperes DC ["Electrical Power Aplenty for the Small Boat," Dec.], the placing of your switch to the right connects battery #1 in the circuit, not battery #2, as the caption says.

SGT. JOHN P. VERENINI
Kincheloe A.F.B., Mich.

The diagram is correct and the caption is wrong.

Curing your hiccups

"Science Newsfront" [Dec.] explains partially why my cure for hiccups works so well. My cure is to have someone push the lobes of your ears in so that they plug the ears. No great pressure is required. Then while the ears are plugged take two or three swallows of water. The swallowing may stimulate the pharyngeal nerves the way the University of Chicago doctors do to cure hiccups, but my method is easier.

RICHARD M. WARD, Grand Lake, Colo.

Corvette fans fight back

That Lucasville, Ohio, reader, Roger McClay, in his "Readers Talk Back" letter [Dec.] about power (like you find in Corvettes) causing auto accidents, must be one of those 50-m.p.h. dudes in the 65-m.p.h. lane. The Corvette's got lots of power to get out of the way of the slow pokes and good ground-gripping to keep from running over them. It's also the best-looking car on the road today.

DON DAVIS, Long Beach, Calif.

. . . McClay's blast at the '68 Corvette and his so-called accident figures of high-powered cars causing 1,000 times as many accidents as underpowered cars is a wild statement. The Corvette's power is coupled to one of the finest-handling packages avail-

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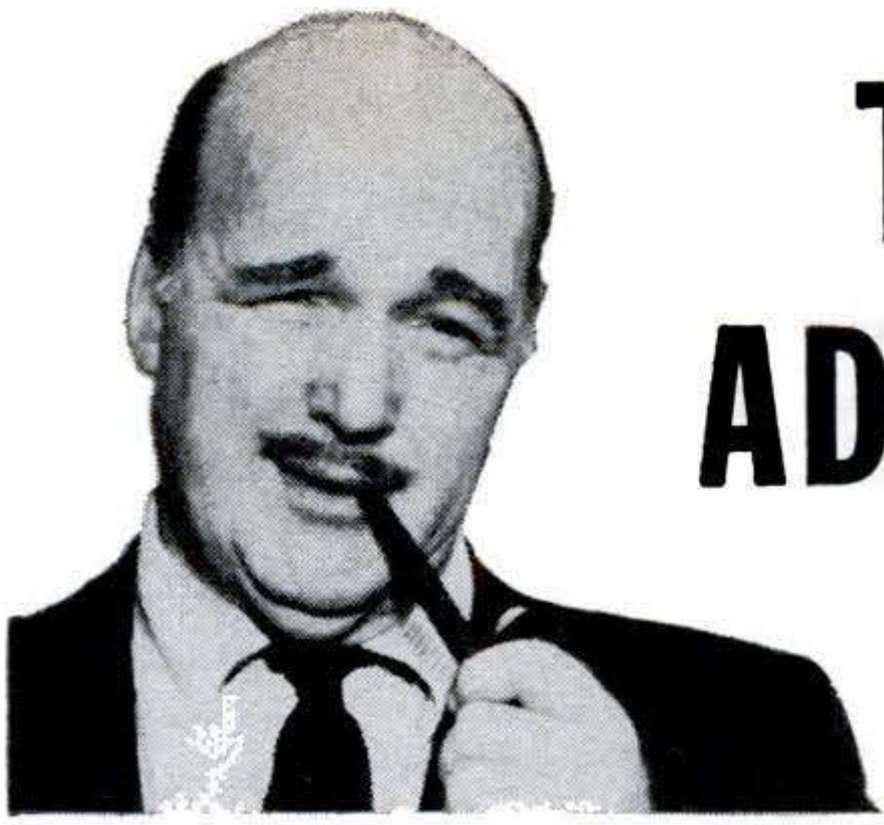

TOM McCAHILL ADVISES SATURDAY MECHANICS

If you're a Saturday mechanic, my guess is you can fix the screen door, build lawn furniture, overhaul the kid's bike, and rotate your own tires.

It's a different story when that fancy electric coffeemaker stops perking or the push-button automatic washer quits halfway through a cycle. You might spend an afternoon admiring the coffeemaker's innards before giving it a permanent vacation on the top kitchen shelf.

As for the automatic washer, after the Little Lady shouts "Do something!" you'll end up phoning an Appliance Serviceman across town. He shows up in 3 days and has the washer going in one-fourth the time it took you to study the coffeemaker. He also presents you with a ticket for 30 bucks. When you consider he could make twice that selling you a new machine, you got off easy.

Maybe you never realized it, friend, but you have more Appliances around your hacienda today than you did five years ago. If you count power tools, your wife's hair dryer, an air conditioner, plus the standard stuff like vacuum cleaner, toaster, refrigerator, freezer and so forth, you probably have well over a dozen.

These electrical gadgets nowadays represent a pretty good chunk of your hard earned dollars. Did you ever stop to think it could pay you in savings and convenience to know how to fix these things? Also, it could be a great source of extra income if you're inclined to tackle the few thousand broken Appliances right in your own neighborhood.

The Appliance Repair business is easier to learn than you imagine. The National Radio Institute's Appliance Division has a downright interesting, low cost course you can take in your spare time. It covers every type of Appliance you can think of plus air conditioning, refrigeration, house wiring, electric motors — even small gas engines. There's a worthwhile section on farm and commercial appliances too.

NRI starts you with the basic principles of electricity to give you a solid background. Using clear-cut picture diagrams, they show you how various types of Appliances work, separating each into groups. Included with the course is a topnotch, professional Appliance Tester for fast troubleshooting.

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Whether or not you agree that knowing Appliance Repair could help you, I recommend you see for yourself. The coupon below will get you a free book that fully describes this unique home training. No salesman is going to call.

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Tom McCahill

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PS Readers Talk Back

[*Continued*]

able outside of Grand Prix machines—with perhaps the best brakes in the world.

DAVID SCHOG, River Edge, N. H.

. . . I agree with McClay that the Vette is a waste of money and too dangerous. Any sensible man wouldn't own one.

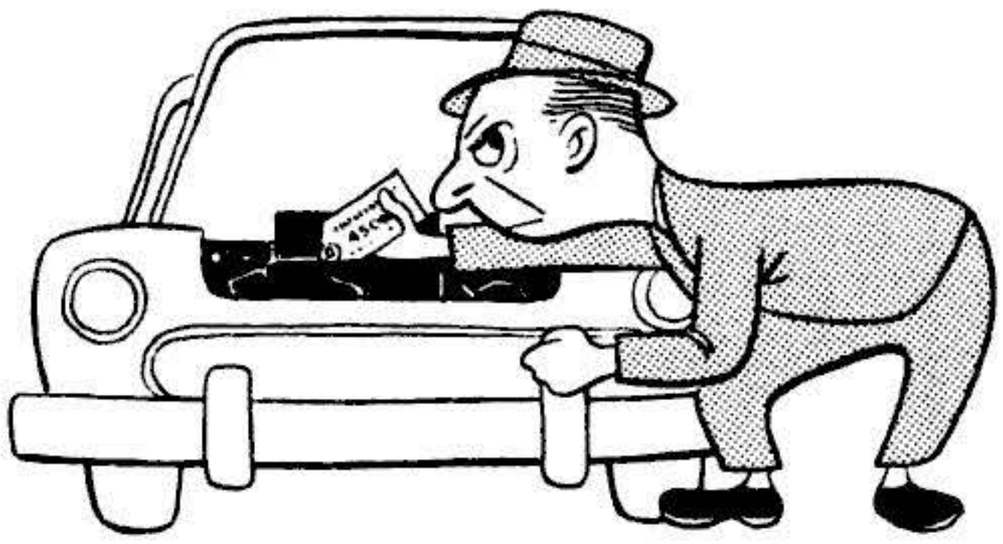
DICK CINELLO Jr., Canonsburg, Pa.

. . . If McClay dislikes your auto editors, he should drive to his newsstand in his "sensible" car and pick up a copy of something more his speed, like *House & Garden* or the *Ladies Home Journal.*

DAVE SULLIVAN, Atlanta, Ga.

More ways to spot mileage cheats

"I'll Cheat You If You Don't Watch Out" [Dec.] reminds me of a time I was almost tricked into buying a car with an odometer that had been set back. I found a tag on the car's radiator that said anti-



freeze had been added at 13,000 miles—even though the odometer had clocked only 10,000 miles. I also found some door-panel stickers which indicated an oil change at 15,000 miles. It's a good idea to look for tags and stickers of this kind, besides hunting for scratches on the odometer numbers.

RALPH C. WECHSLER, Chevy Chase, Md.

ABCs of keeping your car in tune

"How to Take Care of the Electrical System" [Nov.] was a fine article. But one important note of caution was omitted: When removing or replacing battery cables, always remove the ground strap first and replace it last. If you touch a wrench to the hot side while the battery is still grounded, then accidentally ground the wrench—you wouldn't shock anything but your nervous system, but you could cause a fire or damage a good tool. Even a six-volt battery in mediocre condition has amazing zap when directly shorted.

LT. COL. HARRY NUESSLE,
Otis A.F.B., Mass.

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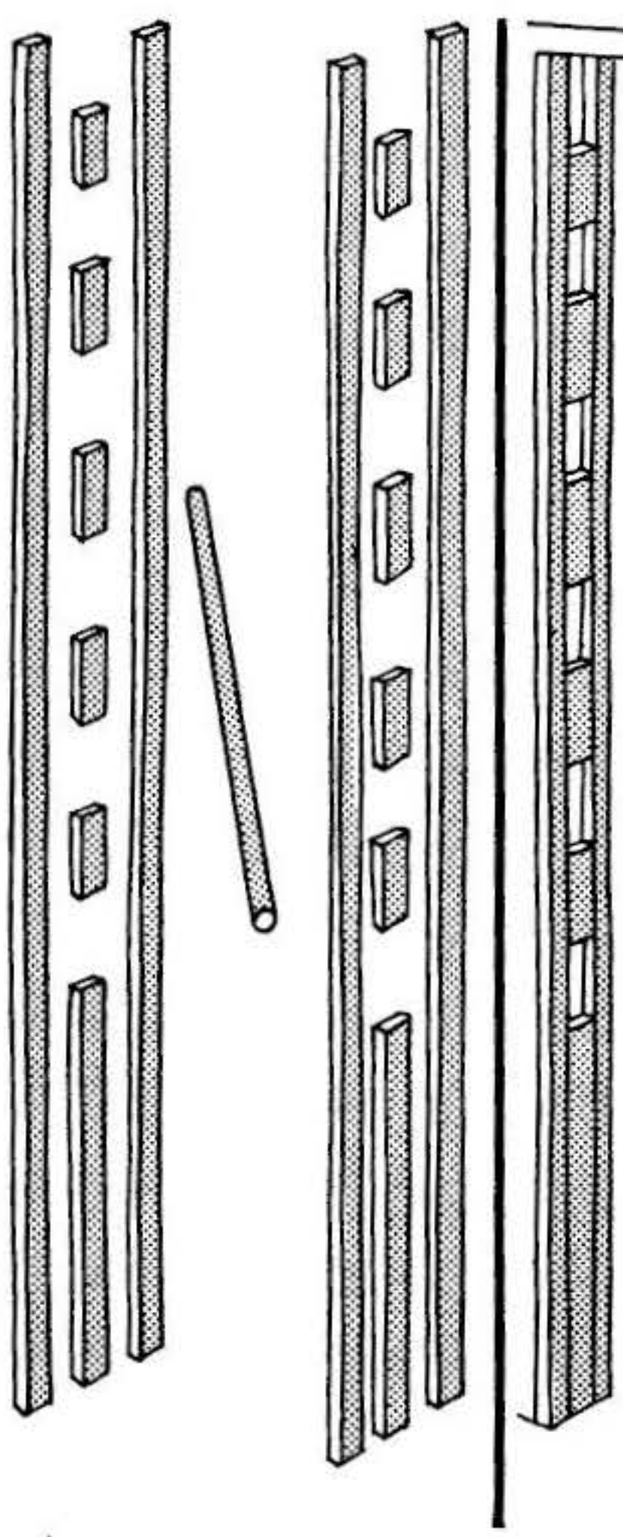
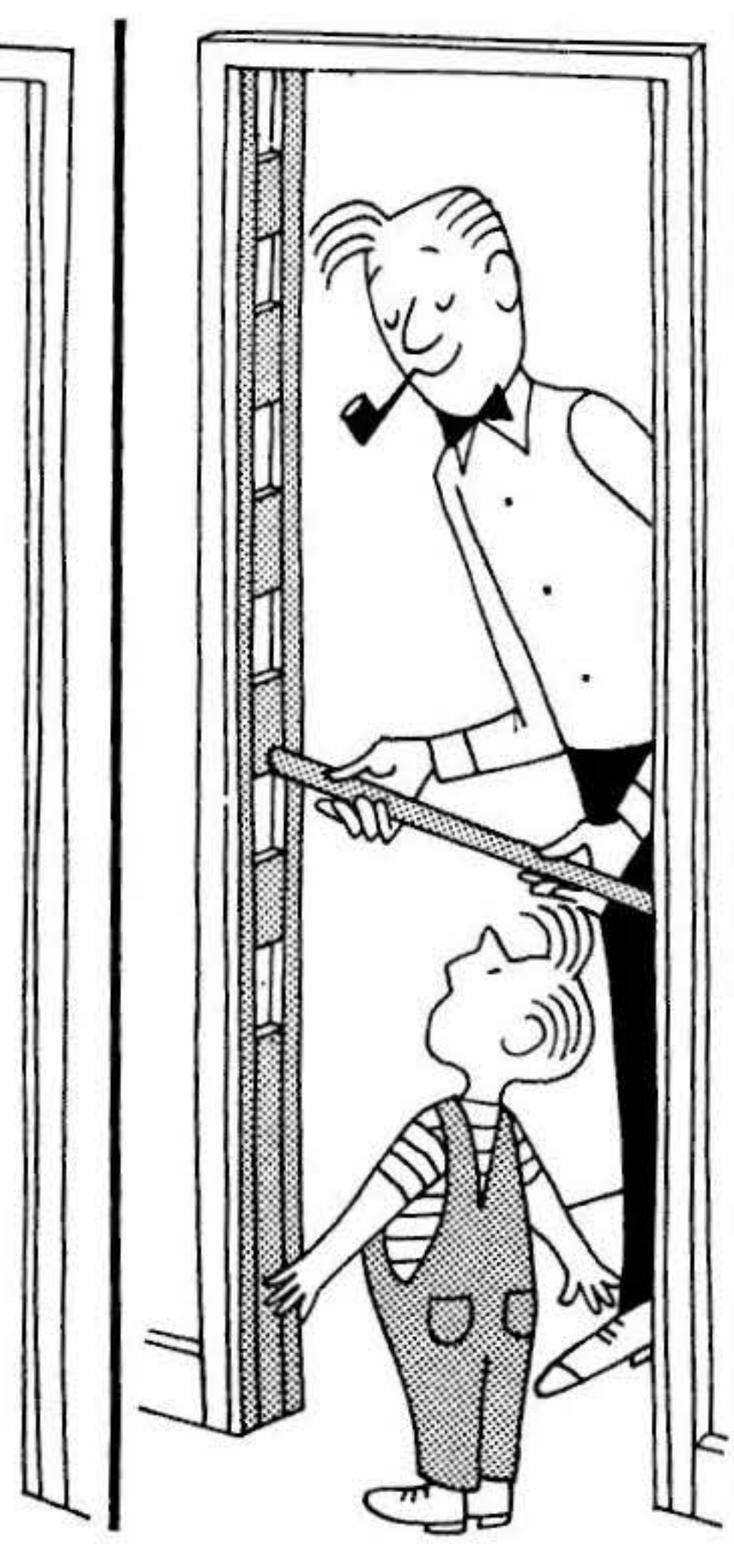
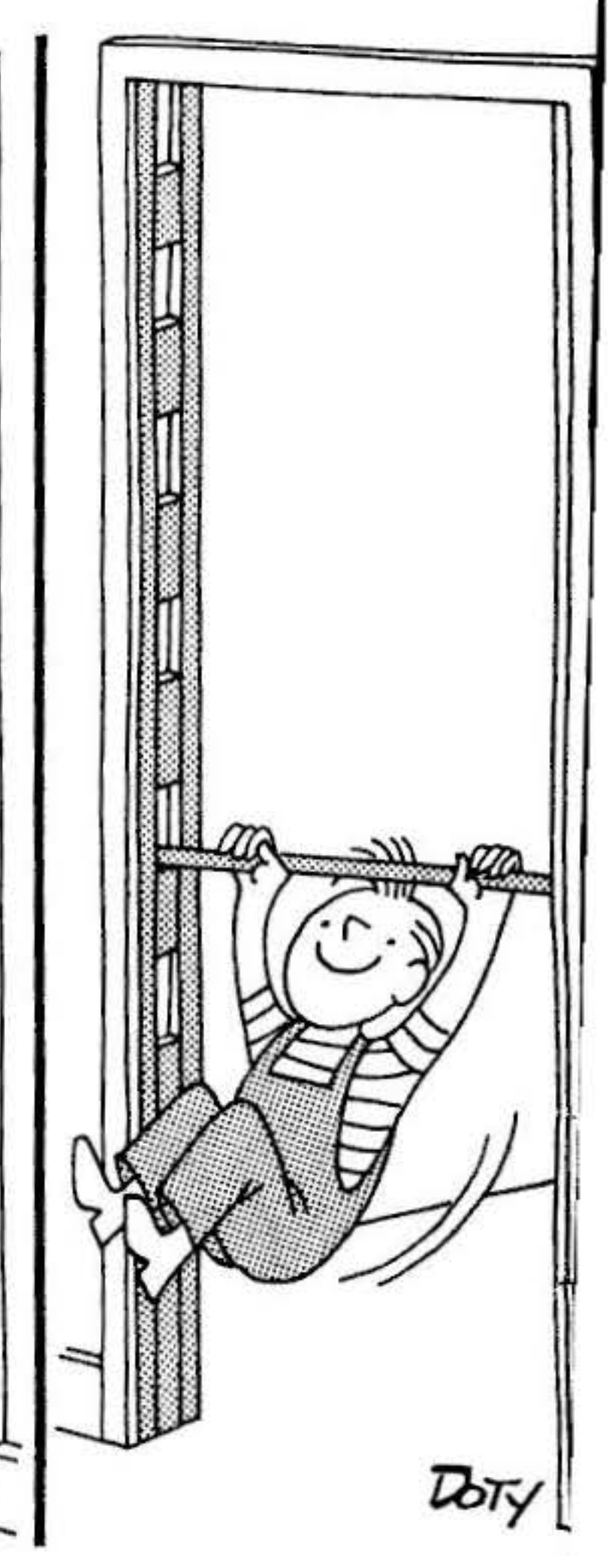
Wordless Workshop

By ROY DOTY







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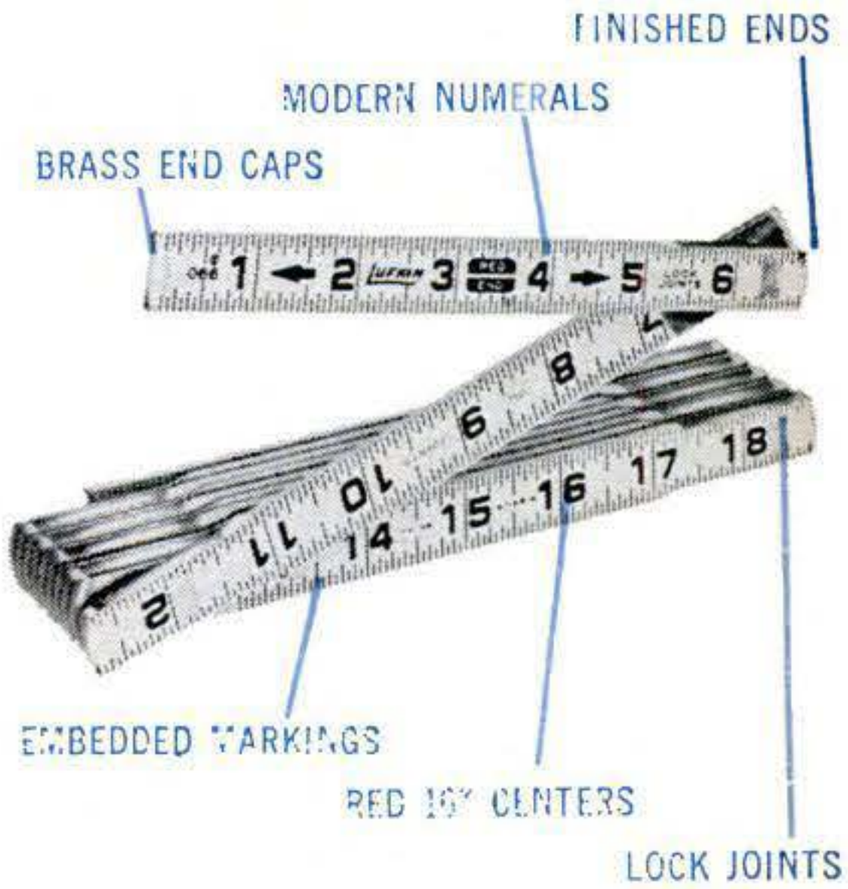

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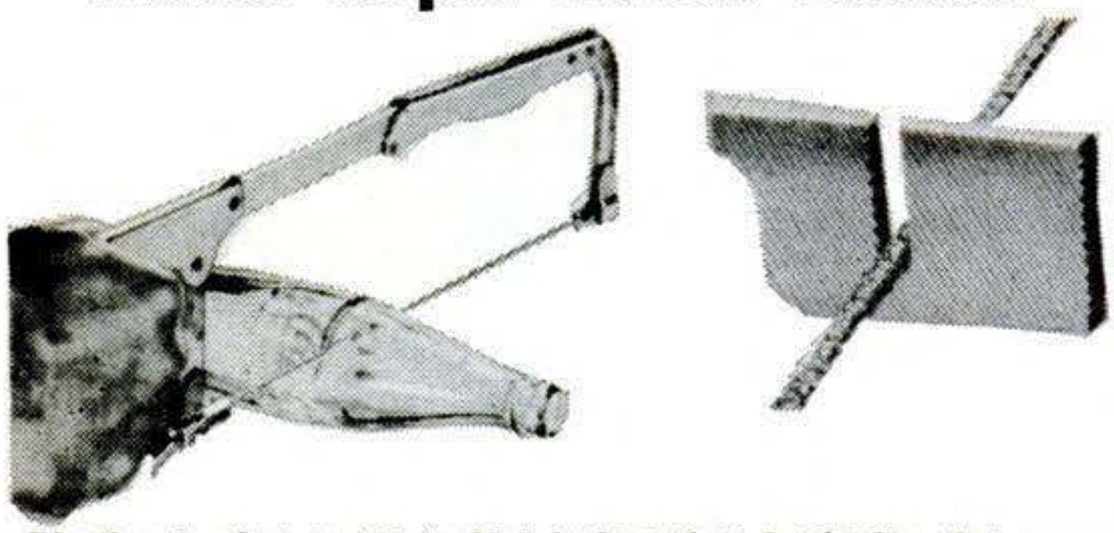

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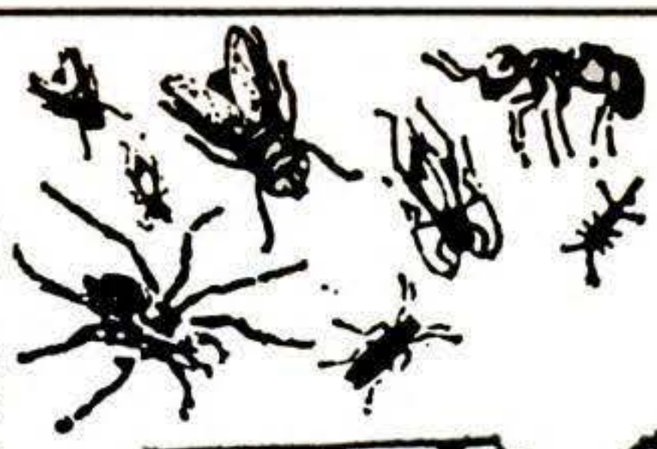

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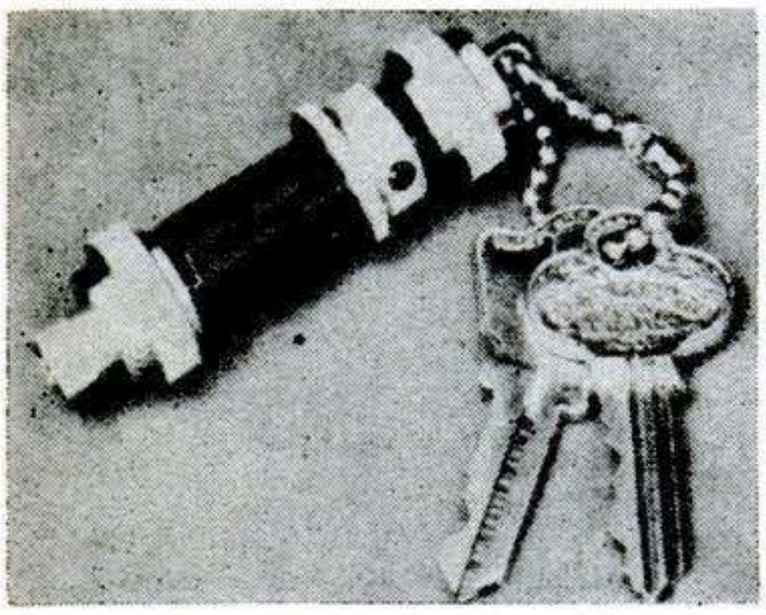

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Let me give *you* the same start I gave these men!

In one way, the big earnings reported here might be called exceptional. In another way, there is nothing exceptional about them. That's because any man who will follow instructions and is willing to work at his own Duraclean business should be able to do as well under similar conditions.

Each of the men quoted here had talents and abilities different from those of all the rest. *But each had one thing in common*—a desire to win personal independence in a business of his own. And each man took five identical steps to reach his goal.

1. Each one read an announcement such as you are reading now. 2. He wrote for complete information. 3. He read the literature we sent him. 4. He gained new confidence in himself and the belief that he could succeed with Duraclean. 5. He accepted our offer to help him get started. Later, he wrote to tell us about his success.

In each case, remember, *the first step was to write to Duraclean for information.* If you would like to own a business of your own, why don't you do as these men did—*right now.*

When I hear from you, I will send you facts about the Duraclean Franchise that will open your eyes. You will see why a Franchise business such as ours makes success for the individual the rule rather than the exception.

The Duraclean home service business has been tried and tested. The market for Duraclean Service is tremendous—and growing. The methods that lead to success have been clearly charted. When an ambitious man follows these methods, success is the logical result.

Some Franchise businesses require investments as high as $50,000. With ours, you can get started for a few hundred dollars and we finance the balance. Monthly payments are so small that the profits on less than one day's service can cover your payment for the entire month. Even with this small investment and operating as a one man business, your potential is $250.00 a week net profit. With two men working for you 35 hours a week, you should gross a profit of $420.00. Allowing 20% for advertising and incidentals, the net would amount to $336.00.

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Ford Marsh
President

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Science Newsfront

Last-minute news and notes to keep you up-to-date

By W. STEVENSON BACON

Taking a shower in space is a problem, but it can be done. This shower was installed in an Air Force KC-135 which flew zero-gravity parabolas while a test subject bathed. Findings in the Martin Marietta project: Water sprayed on the skin flows thickly—like syrup—over the body. When scraped off, it floats about in globules (up to two inches) like soap bubbles and sticks to the side of the shower. Best sprayer is a kitchen-sink mist nozzle. How do you get rid of the water? Simply suck it up with a vacuum cleaner.

The Wankel rotary engine may be one of the answers to air pollution, say researchers. Although doubts were expressed initially about the sturdy little rotary, it was recently demonstrated that its emissions can be greatly reduced by adding a simple "coffee-can" exhaust system. Working on a Curtiss-Wright engine [PS, April '66], a team of University of Michigan engineers, headed by Dr. Paul Cole, cut down exhaust to the point where it would pass even the stringent tests proposed for the 1970s: less than 40 parts per million of unburned hydrocarbons to pollute the air.

The electrical analogue of a permanent magnet, the electret, may make possible a new kind of telephone mike, tiny built-in electrostatic cigarette filters, and a unit to cleanse your car exhaust. Electrets are strange gadgets first made 20 years ago by melting wax in a strong electric field, then letting it harden. Certain kinds of wax will retain a charge indefinitely. Mylar and Teflon were recently found to make good electrets, and last November a patent was granted Northern Electric Co., Montreal, for a way to cheaply mass-produce them. First use: a condenser telephone mike in which an electret is the power source.

What winter slush and salt do to your car isn't pretty to look at, and engineers are still trying to lick the problem of body corrosion. New at Ford is an "electrocoat" process in which entire car bodies (Lincoln and Thunderbird) are dipped into a tank and electroplated with a zinc-rich primer. (As with all zinc primers, the zinc oxidizes and forms a salt that protects the steel underneath.) General recommendations to minimize corrosion: Keep your car as free of dirt, salt, and moisture as possible and *never* store it in a heated garage. Scientists estimate that rusting advances twice as fast with every 10-degree rise in temperature.

Balloon-supported windmills five miles up in the sky would drive generators and send electricity to earth through anchor cables if a proposal of Russian scientists is adopted. Eyeing the windmill as a means of tapping high-altitude, high-velocity winds (up to 350 feet per second), the group would build balloons 725 feet long and 135 feet in diameter to support 1,500-kilowatt generators. The balloons would be made with three layers of glass fiber separated by foam plastic to insure that they would be leakproof and keep their shape. They might also be used as radio-TV relay points.

Easy way to start air-cooled engines used on large lawn mowers, snowmobiles, and other machines is to prop one of the valves open. This, in simple terms, is what is done by the Automatic Compression Release device recently patented by the Kohler Co. Finding

Continued

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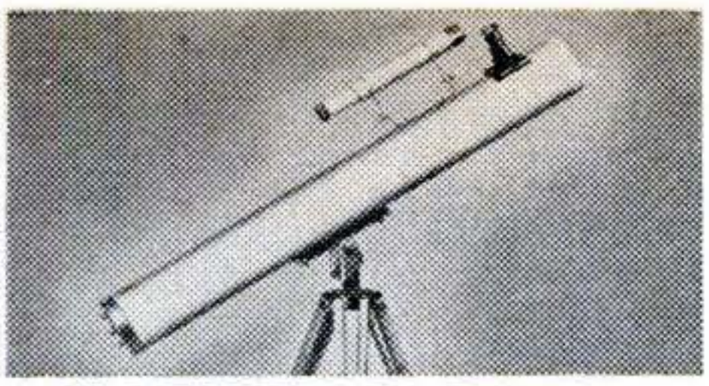

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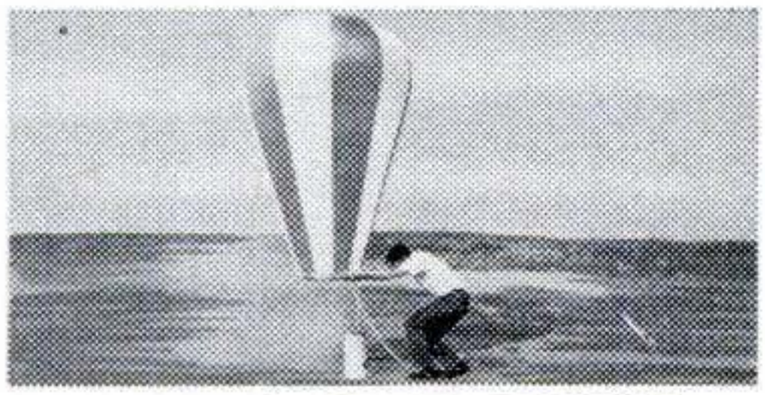

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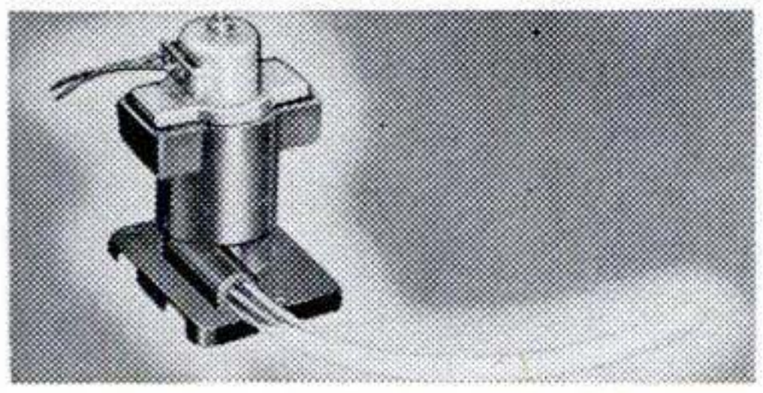

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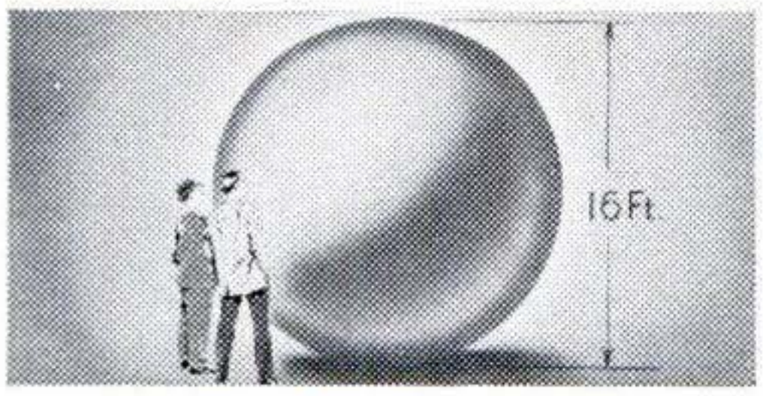

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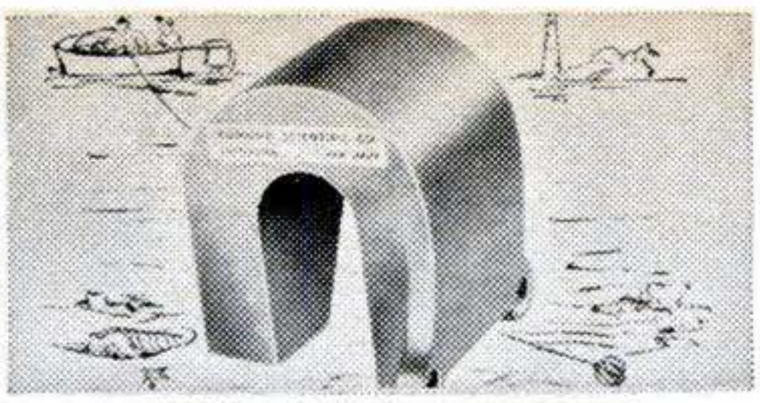

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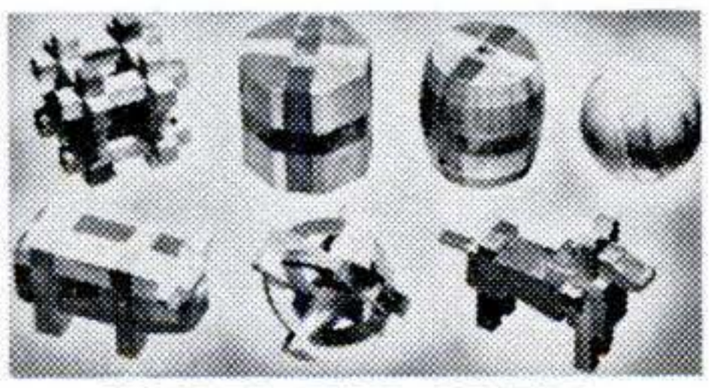

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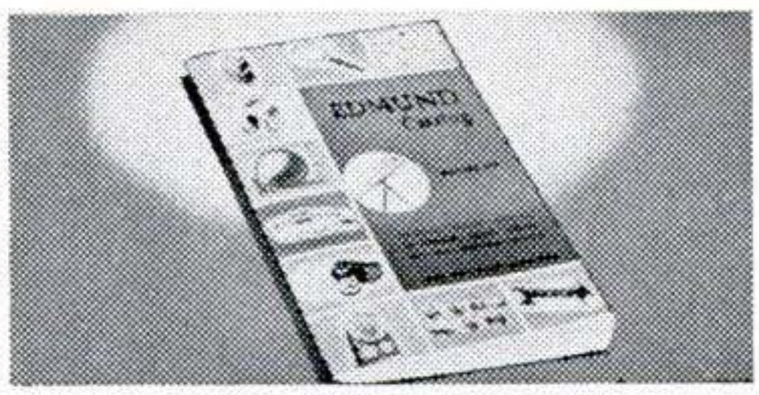

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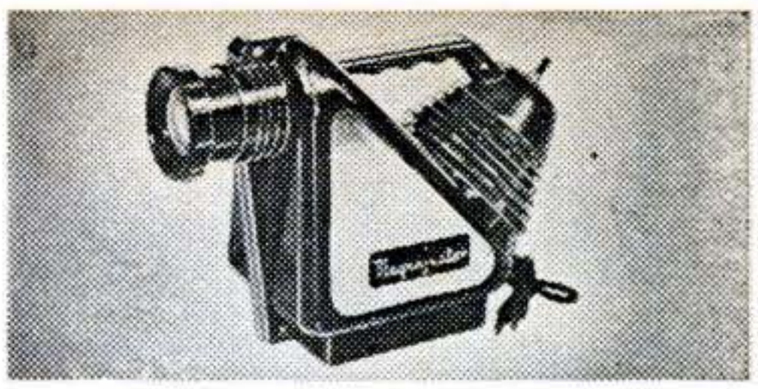

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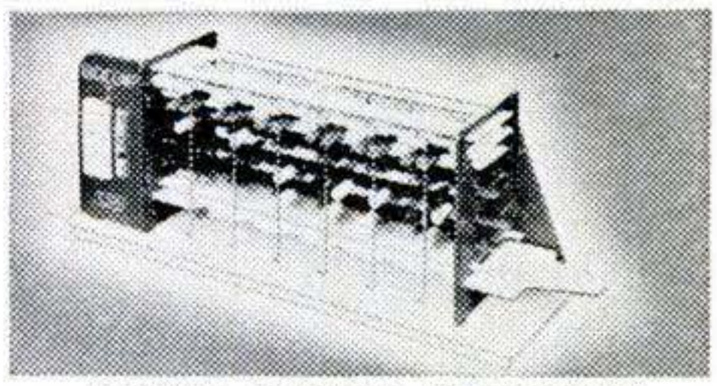

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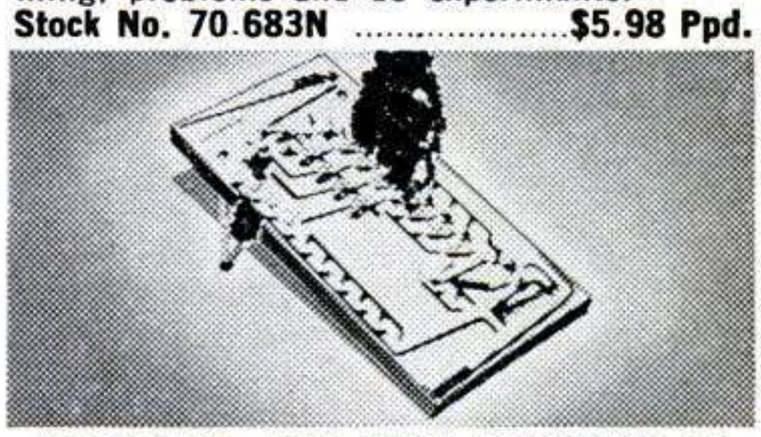

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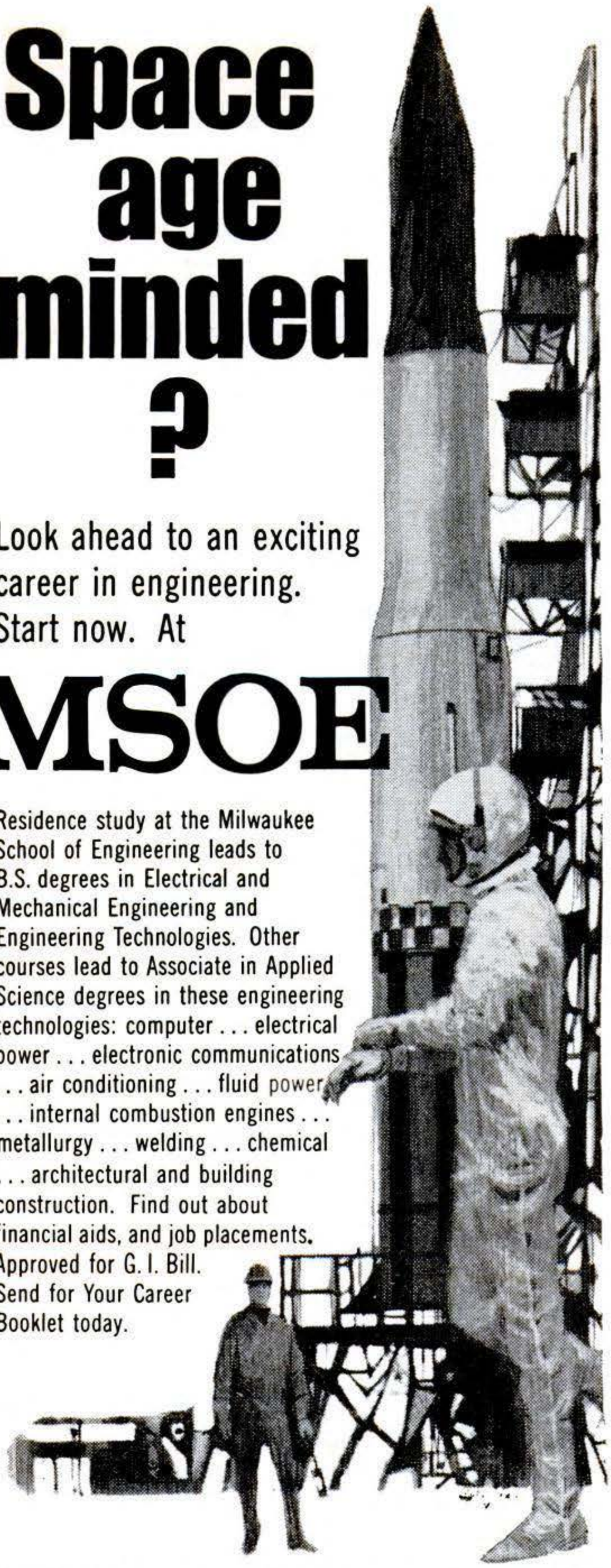

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that even electric starters didn't do the job on large air-cooled, four-strokers, Kohler engineers fitted a centrifugally operated arm to the camshaft of a test engine. At rest and below 600 r.p.m., it holds the exhaust valve open. This cuts compression ratio from 6:1 to 2.5:1 and reduces voltage needed to fire the plug, since ionization occurs easily at lower cylinder pressures. Result? Painless cranking and starting, fewer backaches.

Look for Olympic skating records to fall this month at the Winter Games in Grenoble, France. Reason? For the first time in history skaters will race on ice made from soft water. Not long ago, skaters noticed that times were faster on low-mineral-content ice or in a light, drizzling rain. The answer was found in the laboratory: As water freezes, the minerals separate and give it uneven hardness and density. Soft water is clear and uniform, keeping skates sharp and making for faster times. Culligan, Inc., has surfaced the Grenoble skating track with three inches of soft-water ice—world's fastest.

"To keep from getting old, exercise," say Drs. Herbert A. deVries and Kenneth E. Lersten of the University of Southern California. Now in the middle of six months of testing with 150 men between 50 and 79, the doctors are putting volunteers through stretching exercises, light calisthenics, and walking-jogging. Radio telemetry is being used to monitor heartbeats of the subjects as they exercise, and laboratory instruments keep track of blood pressure, body fat, and oxygen consumption. The researchers are convinced that physical decline in old age is due at least in part to physical inactivity.

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The longest train in the world? A 500-car, four-mile-long Norfolk and Western giant that recently made a 157-mile run between West Virginia and Ohio powered by six

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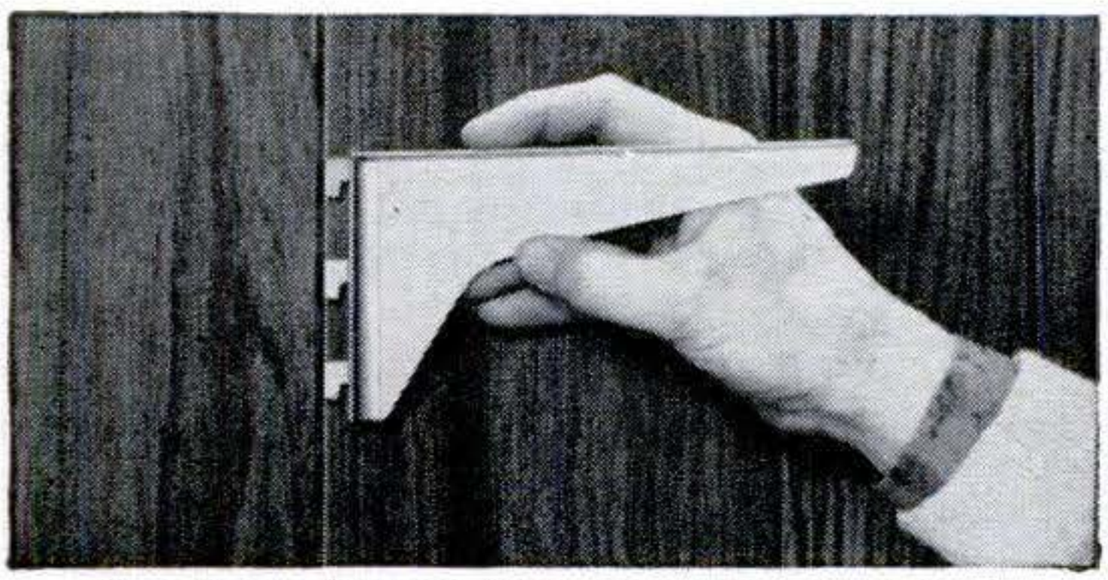

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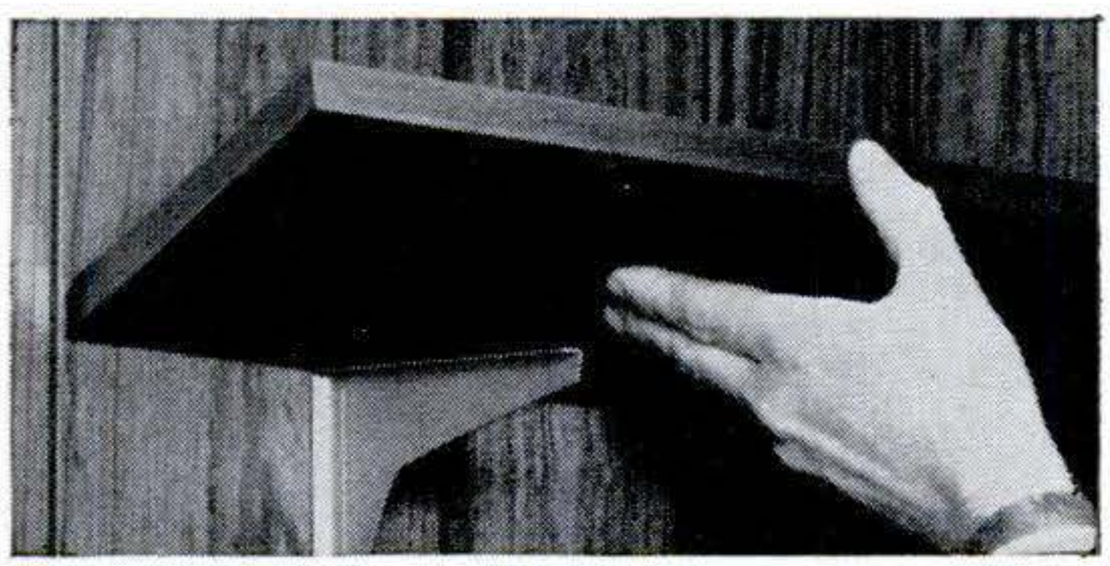

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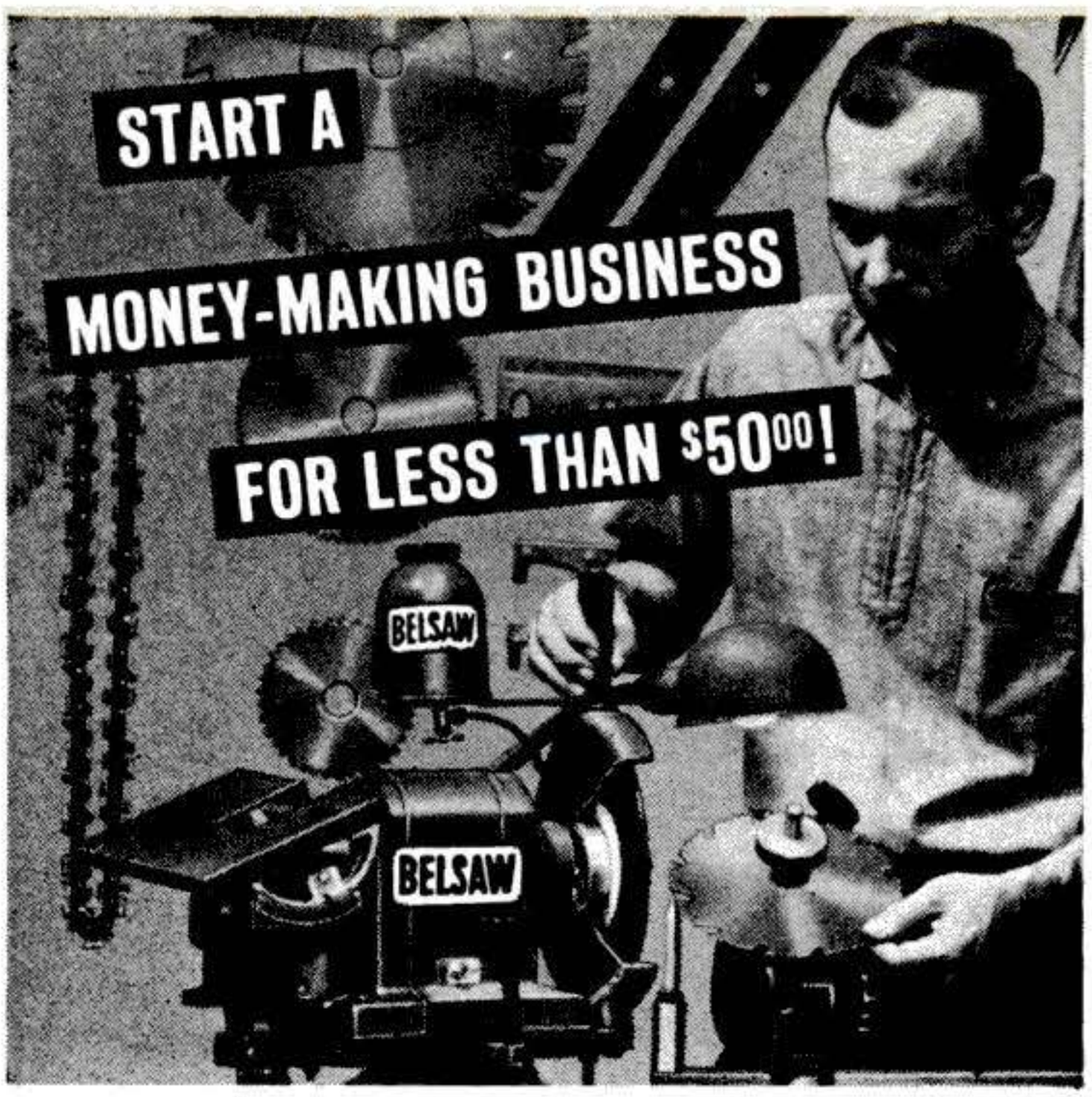

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Science Newsfront
[*Continued*]

3,600-hp. diesel engines. The mammoth freight train (normal length is 200 cars) was made possible by special radio-control gear that converts added engines to "slaves." Coded digital commands are sent by radio to each engine from the unit at the head of the train. Built-in logic circuitry and an error check code insure that each diesel receives only the commands intended for it. The equipment, made by Radiation, Inc., may make giant trains commonplace.

For the first time it will be possible to measure the actual distance to a quasar—one of the mysterious, radiation-emitting bodies thought to be on the far reaches of the universe. Startlingly, it may turn out that quasar 3C-287 is actually a rather close neighbor to earth. According to Dr. Thomas A. Matthews of the University of Maryland, it is only 100,000 or 1,000,000 light years away based on triangulation between it, another previously observed body close to it, and earth. If he's right, photography by the 200-inch telescope atop Mt. Palomar during February will place 3C-287 either close to the Milky Way or about halfway between it and the Andromeda Galaxy.

The fist is quicker than the eye, as witness the fact that the great majority of orbital fractures (fractures of the skull cavities enclosing the eyes) are due to fisticuffs. A survey made by Dr. Orion H. Stuteville of Northwestern University shows that fists caused 69 out of 106 such cases. Nine were from clubs, five by baseball bats, three by bottles, four by the human foot, and 12 by pistol-whipping during robberies. Stuteville, a maxilofacial surgeon, points out that while early treatment of orbital fractures is fairly easy, they can cause serious sight damage later on—a distinct medical problem that has never been recognized.

Warning to burglars: Next time you pull a job, make sure you don't stop for a snack. And above all, avoid cheese. In one of the most unusual whodunits ever, Dr. Robert E. Patchin, associate professor of basic dental technology at Case Western Reserve, was asked to show that a certain suspect had committed a burglary. The clue? A piece of cheese, with teeth marks, found at the scene. Comparing the suspect's toothmarks as recorded in wax, the police had their evidence—as good as fingerprints. Under a microscope, Patchin showed that tooth striations—determined by size of teeth and jaw, root shape, fillings, bridges, and spaces between teeth—matched perfectly. PS

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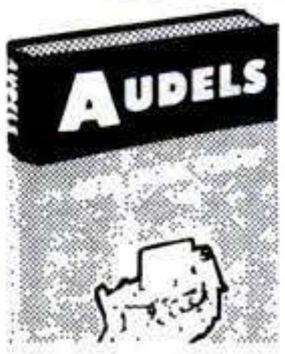

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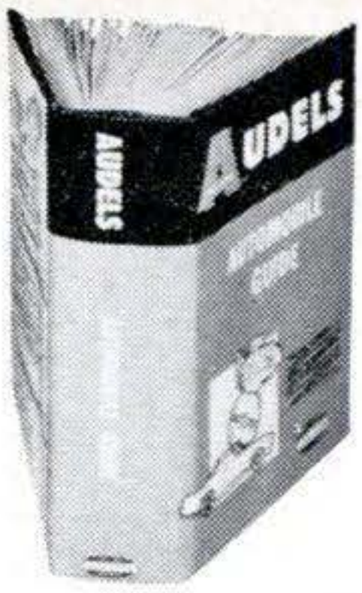

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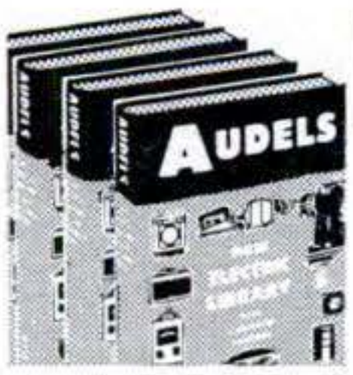

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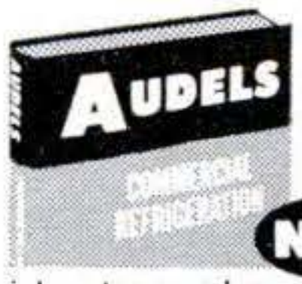

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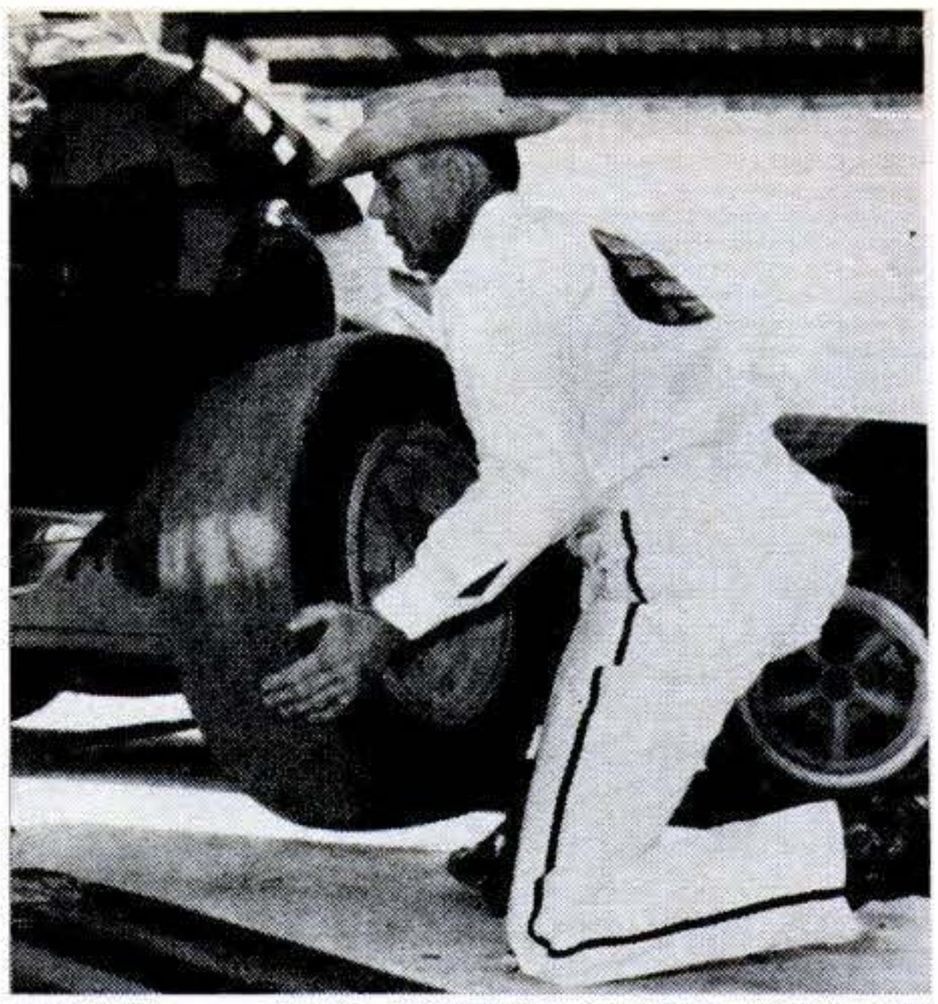

"I have a 1962 T-Bird with knee trouble. The front springs bow in and rub the body of the shocks, which are new extra-heavy Monroe-matics. The Ford agency says the springs are shot. A local mechanic says the upper-arm bearings (or something) are bad, and parts and labor would cost $68.50."

HENRY C. SMITH, Los Alamitos, Calif.

There is no mystery about your problem. If you were overweighted, as that model Thunderbird is on the nose, you'd have knee trouble, too. Have a front-end and alignment specialist tear down the front end and check it for wear and spring sag. I'm sure he'll find worn ball joints and inner A-frame bushing wear. When he has replaced worn parts and lined things up to specs, she'll stand up.

"My dealer says I should use only the Volvo oil filter in my '65 Volvo 122-S, since that one alone has a pressure valve. He said if I changed to any other type of filter, I should change oil each 1,000 miles instead of the 3,000 recommended for the Volvo filter. I'm currently using a filter with an antacid anode with an extremely high filtration rate. Would that be safe for 3,000 miles?"

PHILIP VAN LEEUWEN, Huntsville, Ala.

Stick with the Volvo-recommended filter unless you are qualified to analyze the results on the one you're trying.

"In 40 years of driving I have yet to drive a pickup truck that gave me over 12 miles per gallon. Would a two-speed rear end help?"

KEITH P. CLARK, Parker, Ariz.

Forget the two-speed. Get the right kind of truck. For example, I have in mind one company's pickup with a 305-cube V-6 and a 3.07 axle. With that rig, if you stay within the speed limit, you're in for a pleasant surprise. I'd guess that you've probably been using low rear-end ratios and driving too hard.

"Mercedes-Benz advertises a diesel-engine automobile that has no carburetor, no distributor, no condensers, and no spark plugs. Would you please explain how it works?"

REUBEN E. STONE, Rockville, Md.

Like all diesels. Fuel is injected—that is, sprayed—into each cylinder at the proper instant. The heat of compression, much higher than in the gasoline engine, ignites the fuel, making electrical ignition unnecessary. Injectors and their components are more expensive and highly complex as compared with a carburetion-and-spark system. Diesels run well, cost little to maintain, and deliver good fuel mileage. However, they are more suited to trucks or buses than to passenger cars—unless noise, odor, vibration, and low torque don't bother you.

"Brakes on both my '66 Bonneville and '60 Corvair have pulsating action, especially when warm. I had the drums turned on both cars, and put a new set of linings on the Corvair. The condition still exists."

HOWARD SHONTZ, Ellwood City, Pa.

Assuming your tires and wheels are fairly true, and the drums round and not too thin, and mounted right, you shouldn't have pulsating brakes. More "pedal-breathing," as we call it, when brakes are warm than when cold, usually means poor lining contact and thin drums.

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"Say, Smokey—"
[*Continued*]

"I purchased my 1966 Buick Gran Sport in California with the state-required air-injection-reaction unit on it. When I moved to the East I took the unit off. With it, the car performed poorly and gave poor fuel mileage. Recently I installed a new 1966 Carter four-barrel carb of the same type as the original, less the parts needed for the California anti-smog system. Now the engine is more responsive, but I have acquired a smoking exhaust, and my gas mileage is getting worse. Along with this, the gas gauge has always dipped with any kind of acceleration, and I have to play guessing games with it."

KEN R. MANOWIECKI, East Paterson, N.J.

Most of the time, removing factory-installed smog gadgets doesn't work out too well because of the many changes needed to get back to the correct carburetion, ignition, and crankcase venting. Have your cylinders checked with a Sun cylinder leak-down outfit to get the answer to the smoky exhaust. Then get a tune-up, with special attention to proper crankcase venting. As for the fuel surges, they register pretty heavy in the low, wide tank in your car on rapid acceleration or hard braking.

"Is there anything harmful about feeding a tablespoonful of flake graphite through the carburetor throat every 100 miles?"

F. PRUSA, Lyons, Ill.

Not unless you object to its coming out the exhaust pipe. That's where it's going.

"I use my '66 Plymouth six only for short runs of about a mile each way daily, to and from work. I have to change oil long before due time because gasoline from the automatic choke dilutes it. Add a manual choke?"

RICHARD D. PARKER, Saco, Me.

Yes. But you would still be driving a cold engine most of the time. That's harmful in ways other than diluting the oil. Why not put an engine heater in it? Use it at home for the morning start, and again before you start home. There are head-bolt heaters, dip-stick heaters, and oil-pan heaters. Some are electrical. Some are fuel-powered. If you continue to use the automatic choke, you should have the unloader and choke set leaner, and add a radiator or grille cover.

"I've heard that the best tires on a car should be put on the rear, and the opposite opinion, too. What's true, and why?"

RAY GIBOULEAU, Woodland, Me.

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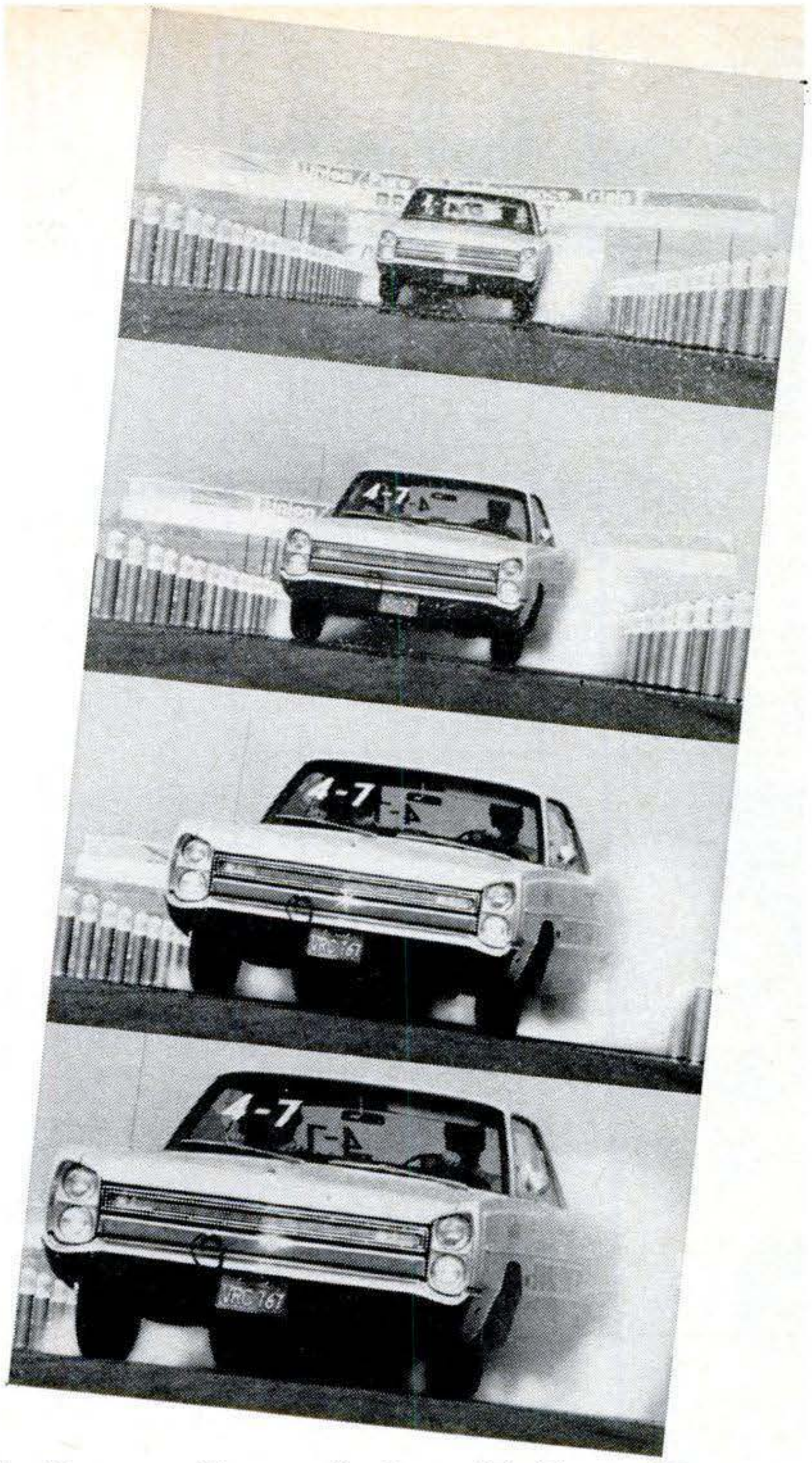

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YOU CAN WIN

That's right... if you had been a member of our **Puzzle Lovers Club,** you could have won thousands of dollars. This year, our Club is offering a minimum of $100,000.00 in cash awards to Club members just for solving puzzles in their leisure time... IN THEIR OWN HOMES.

Each month, people like yourself, who love to solve puzzles, but never before won any money, share in the fun and excitement of our contests and walk away with cash prizes that add up to many thousands of dollars . . . AND SO CAN YOU!

Our **Puzzle Lovers Club** winners are people just like yourself... men and women who never believed that they could have the kind of money paid to sports, TV and movie stars. Our gifted winners have used their cash prizes to do the things they've always dreamed about... pay off the mortgage, take a long vacation, start a farm, buy a new wardrobe, install air conditioning.

Here are just a few of thousands of winners: Over $1,000.00 in cash to a Maryland fan; $2,500.00 cash award to a Colorado gentleman; $1,250.00 cash to a San Diego contestant; more than $2,500.00 to a Pennsylvania Puzzle Lover.

How would you feel if you won $5,000.00? "It's a thrill that comes just once in a lifetime," said Mrs. Carl Mouness of La Crescenta, Calif., as she received her cash prize. Men and women of all ages have won tremendous cash awards from our **Puzzle Lovers Club.**

Frances Nation, Puzzle Lovers Club winner from Oklahoma City, was overjoyed as she received her $305.88 award.

"Thank you for that beautiful $1,400.00 check," was the way Sue Repetto, Fort Worth, Tex., reacted to news of her victory.

"I felt that I had a winner," wrote Robert Dallons, Aurora, Colo. He's a contestant who was awarded a $2,500.00 cash prize.

WIN CASH

HERE'S YOUR CHANCE TO TRY OUR CONTESTS AND SEE HOW MUCH YOU CAN WIN EACH MONTH

How do they do it? They are members of the world's only puzzle club that holds regularly scheduled competitions and offers cash prizes to winners. Membership in our Club offers you the fun and excitement of puzzle solving, educational information on how to use language and words, the opportunity of winning thousands of dollars each month PLUS extra bonus puzzles each year with prizes ranging all the way up to $100,000.00. Our **Puzzle Lovers Club** limits competition and awards to members only. Our membership is kept small, so that your pleasure, excitement and cash prizes are B-I-G!

Edna B. Dupler, Millersport, Ohio, walked away with $500.00 in Puzzle Lovers Club contest cash. "My friends said I was wasting my time."

ABSOLUTELY FREE

Don't send a penny... see if you have the talent to win... right in the privacy of your own home. Your "ticket" to fortune offers you a FREE sample copy of our **Puzzle Lovers Newspaper**... AT NO COST TO YOU! As a member of our Club, you can look forward to fun, excitement, thrills and education. You'll enjoy fascinating hours of friendly competition with men and women like yourself.

AND YOU'LL HAVE DOZENS OF OPPORTUNITIES TO WIN EXTRA CASH IN YOUR SPARE TIME!

There is no obligation to enter our contests. If you decide to compete for our money, there's nothing to buy, no jingles to write, no boxtops to send. WHEN YOU WIN, THE MONEY IS IN YOUR HANDS WITHIN ONE WEEK. No other contest group in the world pays you faster than our **Puzzle Lovers Club.** Discover how you, too, may cash in by doing our puzzles in your leisure time.

CLIP YOUR "TICKET" TO EXTRA MONEY RIGHT NOW! YOU MAY RECEIVE YOUR FIRST BIG CASH PRIZE IN JUST A FEW WEEKS

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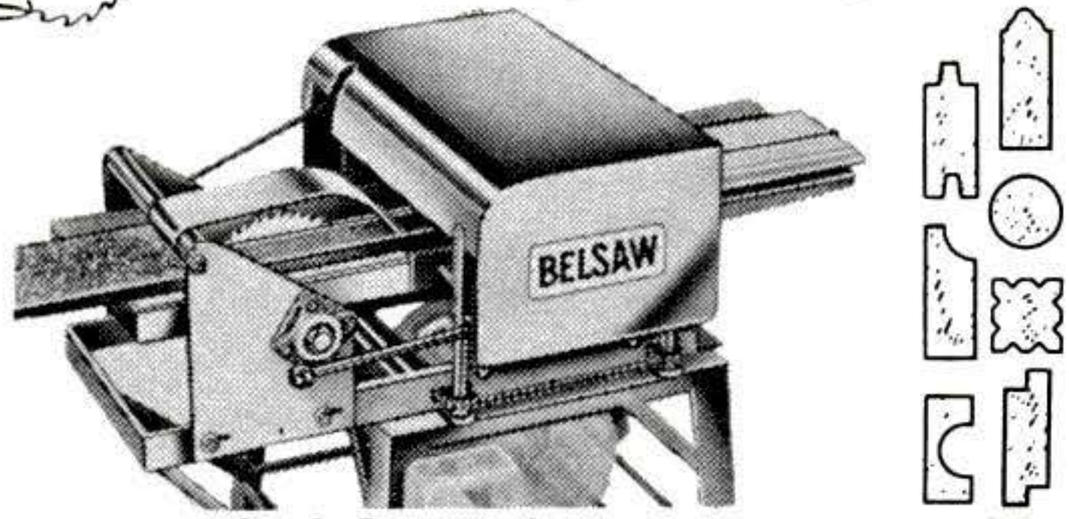

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[*Continued*]

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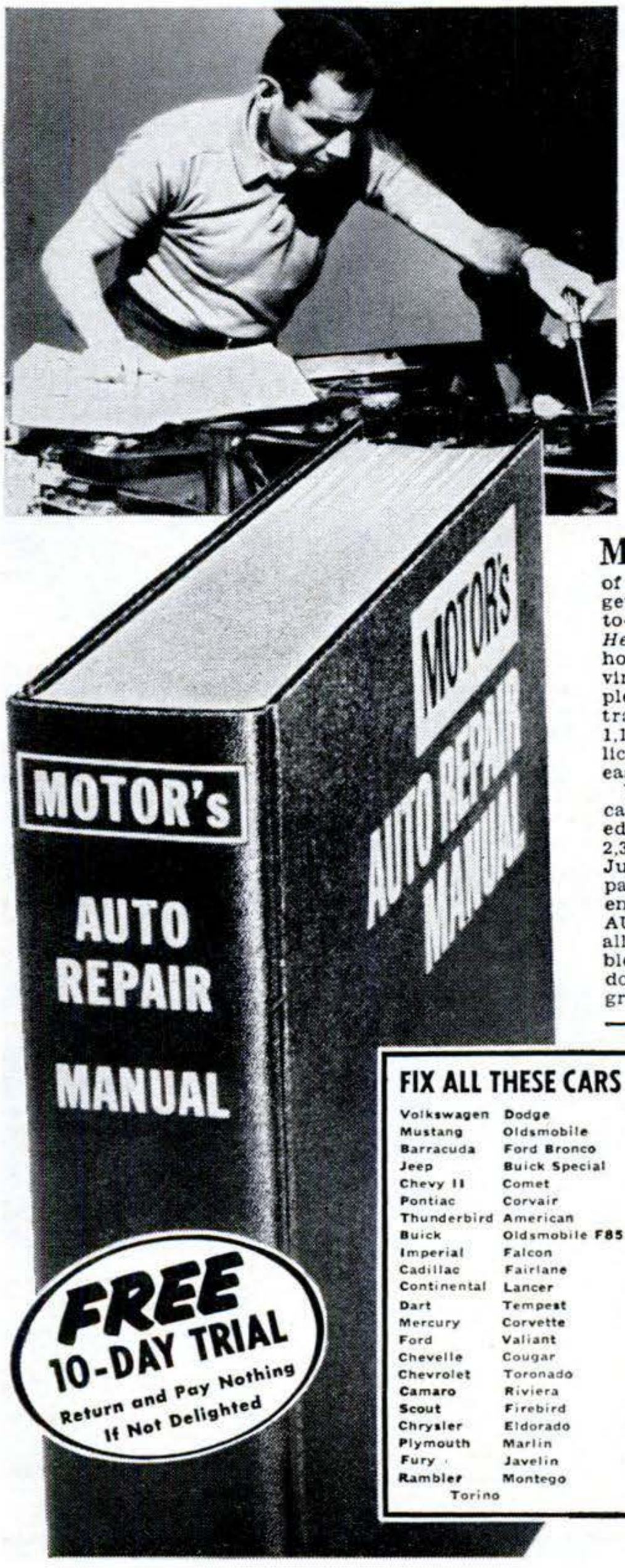

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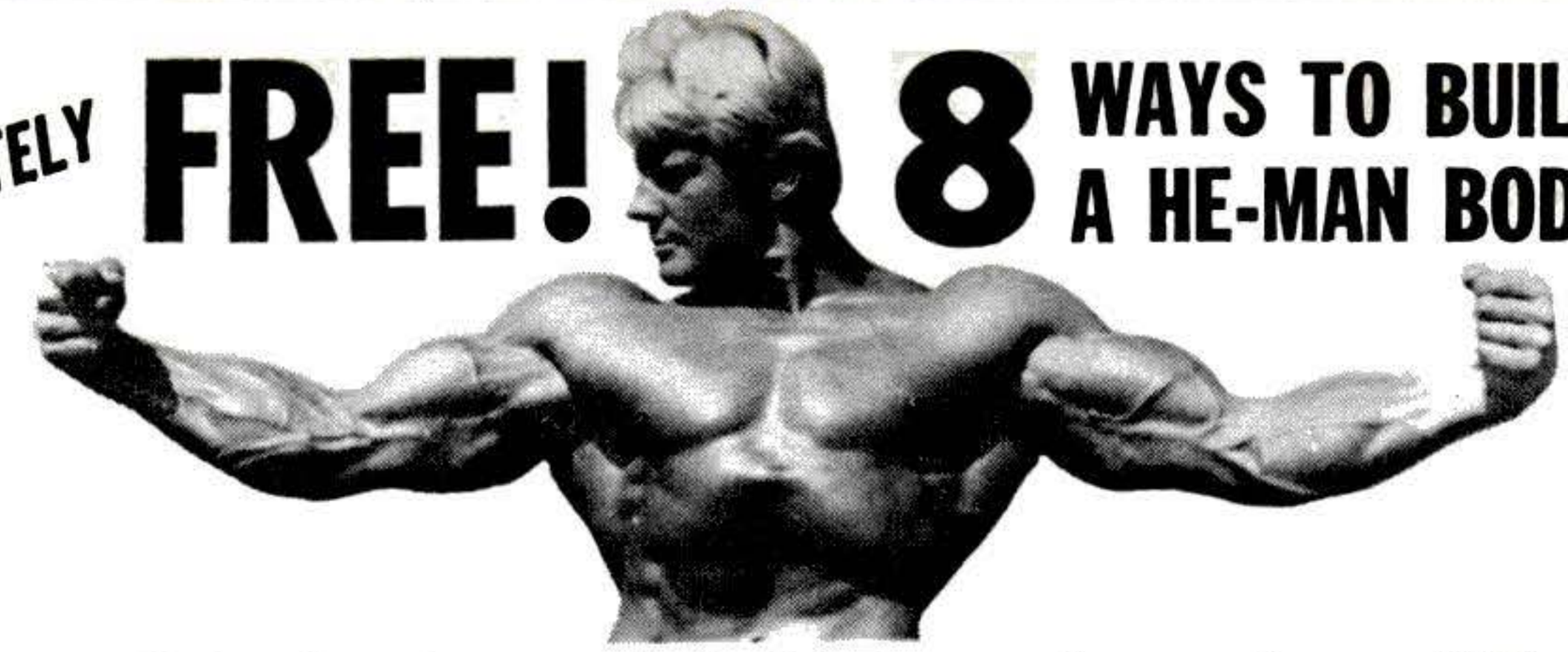

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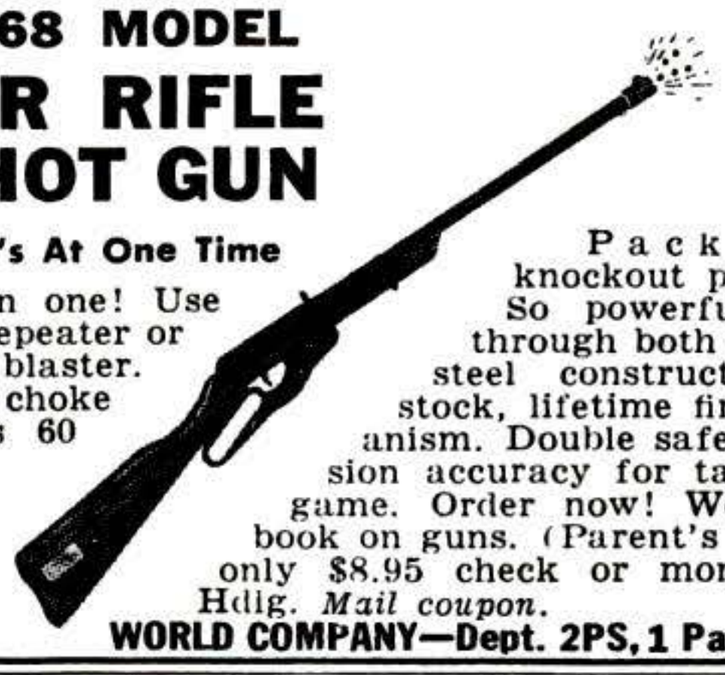

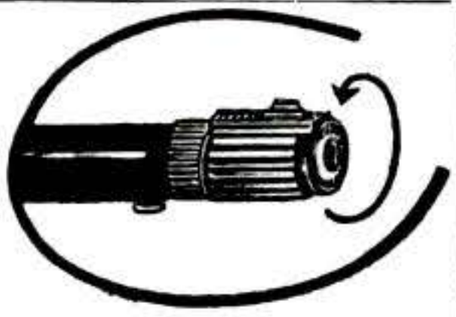

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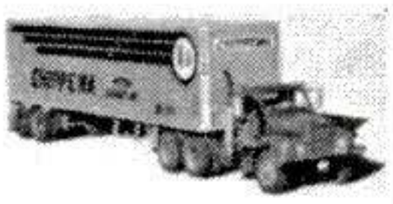

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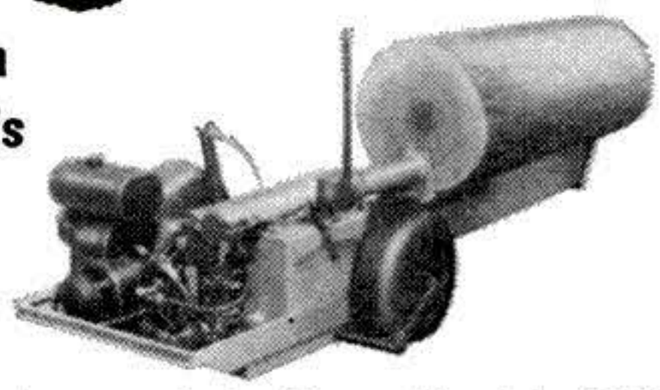

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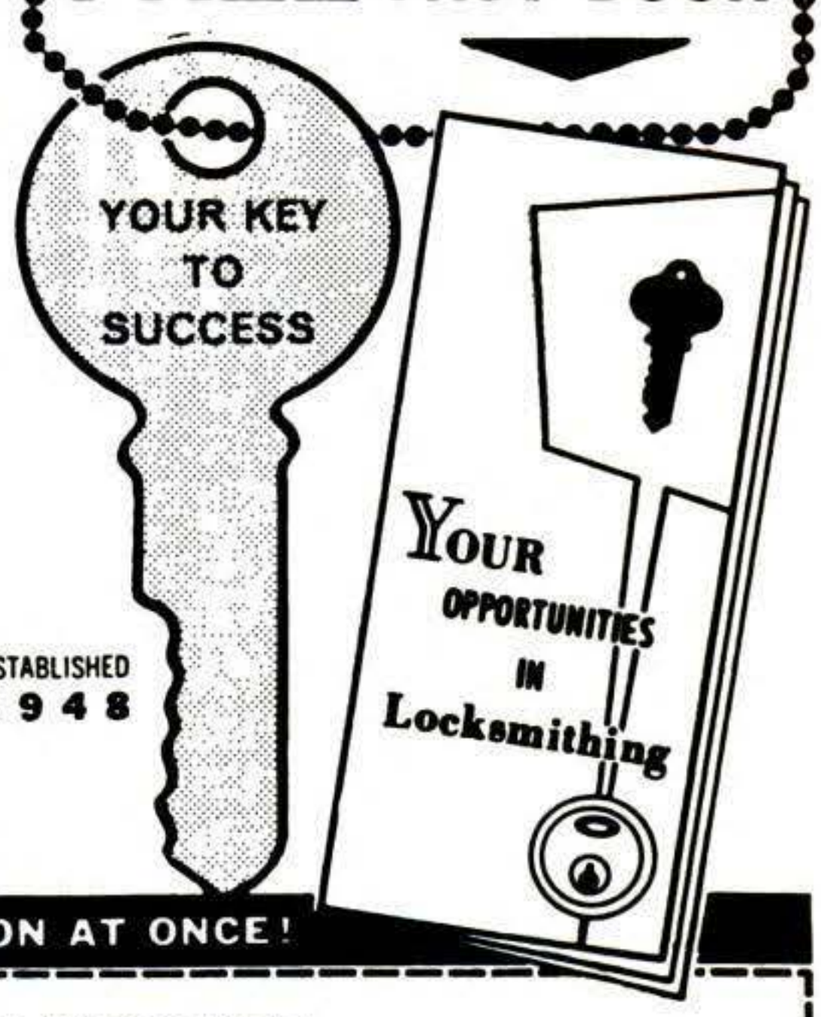

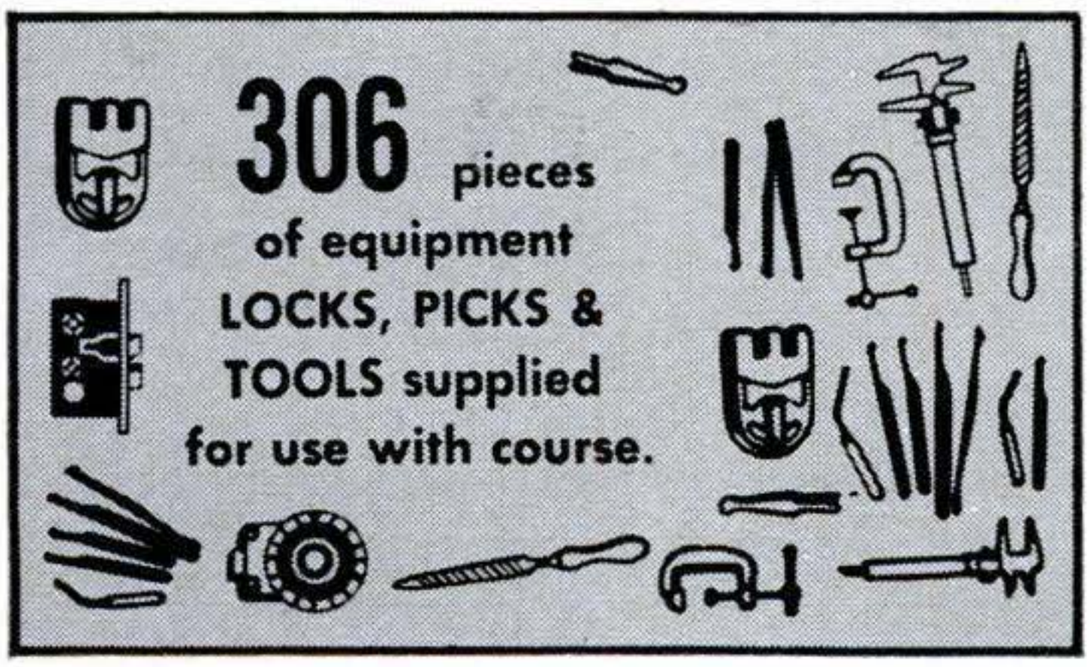

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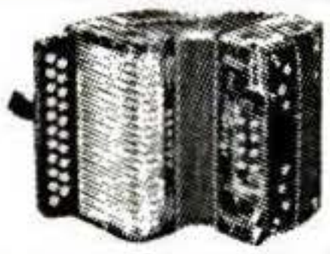

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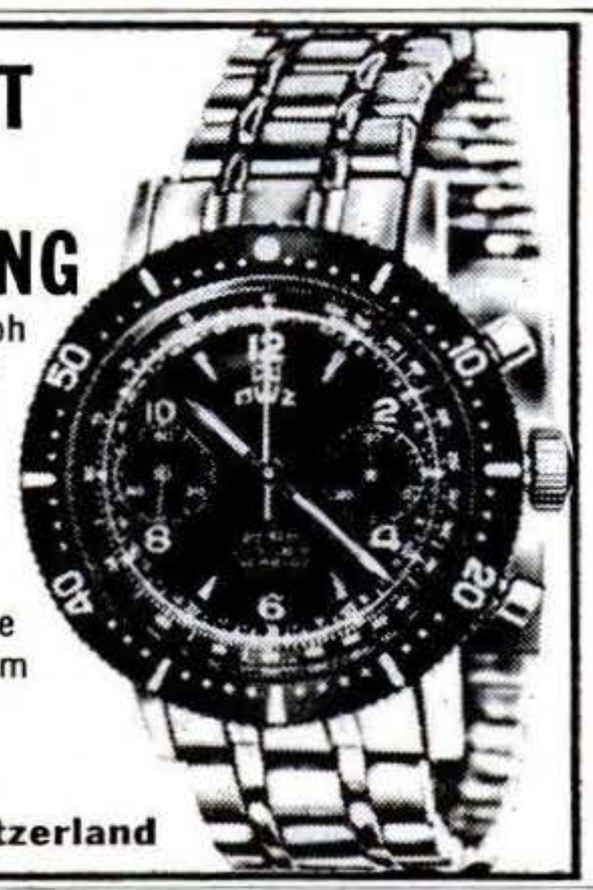

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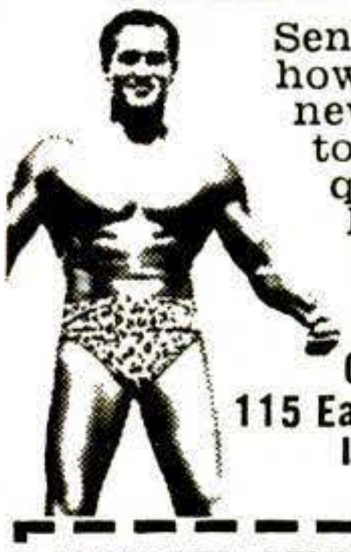

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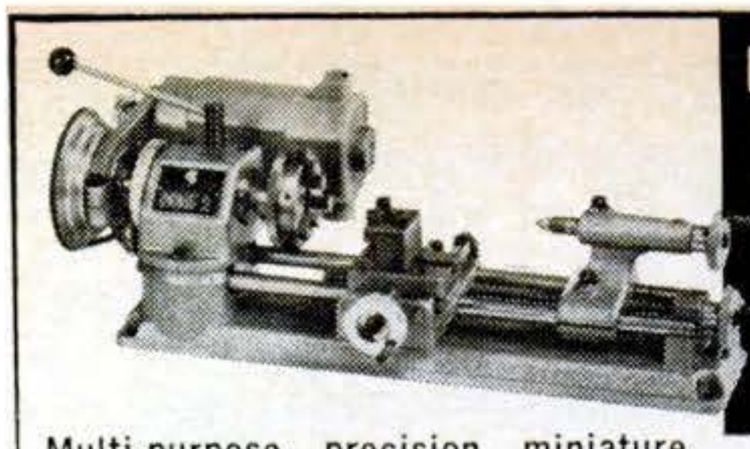

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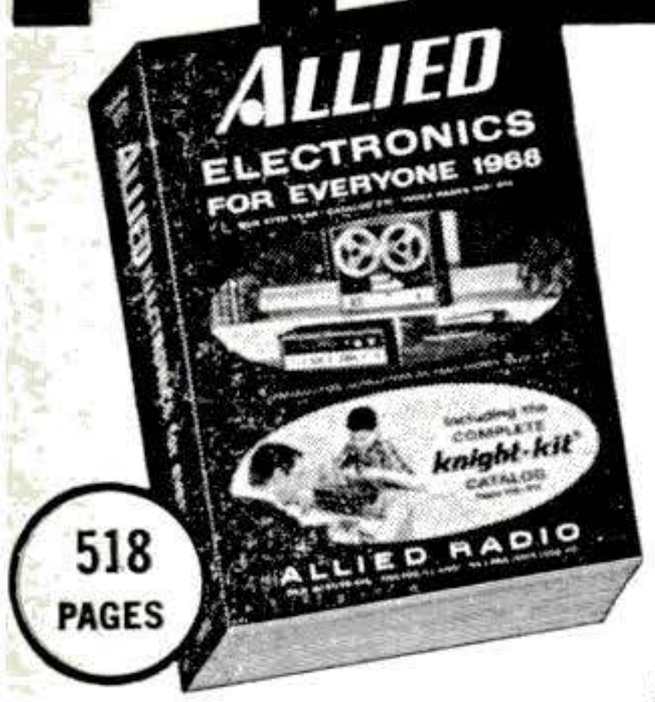

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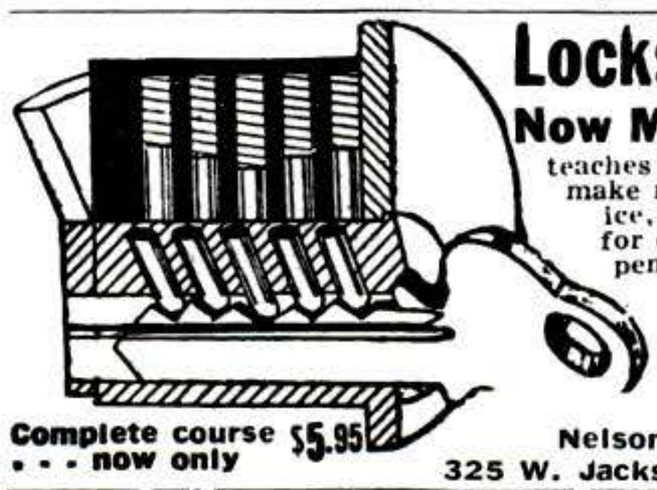

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5146 STOCKMEN BLDG., ELKO, NEVADA 89801

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How to get rich

How can you get rich some day? Make a hit record . . . a killing on the stock market . . . or invent a gadget like the hula hoop?

For most of us, these are just dreams. But have you ever stopped to think that there *is* a way to get rich—possibly only one sure way? Most fortunes, as you know, are made by people who own their own business.

Perhaps you've thought of starting a small business of your own . . . a franchised drive-in, or maybe a service business. Trouble is, you need $10,000 to $15,000 to get started and even then it's a gamble —with slim chance of ever making really big money.

But there is *one* business which could make you rich—almost overnight. And the beauty of it is, you can start on a shoestring during your spare time, even while holding your regular job.

Cash by Mail

The business is Mail Order—and it's fabulous! Come up with a 'hot' new item . . . and WHAM!

It strikes like a bolt of lightning!

Suddenly, you are deluged with cash orders from all over the country . . . MORE MONEY than you could ever make in a lifetime!

Like the Vermont dealer who ran one ad in Sports Afield Magazine. His ad pulled 22,000 orders—over A HALF MILLION DOLLARS IN CASH!

There is no other business where you can make a fortune so quickly!

- A beginner from Newark, N.J. ran his first small ad in House Beautiful—offering an auto clothes rack. Business Week reported that his ad brought in $5,000 in orders. By the end of his first year in Mail Order, he had grossed over $100,000!
- Another beginner—a lawyer from the midwest, sold an idea by mail to fishermen. Specialty Salesman Magazine reveals, "he made $70,000 the first three months!"

Proof

It's a fascinating business! Running ads in newspapers and magazines . . . mailing gift catalogs . . . getting cash orders in your daily mail—steady as clockwork.

There is no other business where you can start on a shoestring and pyramid your profits—*without investing in merchandise!* One husband and wife mail order team took in $40,000 selling one item. They obtained FREE ads in national magazines . . . didn't invest a cent in merchandise, and even got the supplier to ship all orders for them!

These exceptional cases are absolute proof that *you can get rich* in your own Mail Order business. Very rich. Even a U.S. Gov. Report stated: "A number of one-man Mail Order enterprises make up to $50,000!"

Pick up any magazine. Notice how the same mail order ads are repeated . . . month after month? That's concrete proof! You know those ads wouldn't be repeated over and over again—*unless* they were bringing in big cash profits to their owners.

The Secret

The secret of getting rich in Mail Order lies in *financial leverage*. It's a little-known, almost secret method—using other people's capital to make money for you!

You can get thousands of dollars worth of advertising in big national magazines—without investing your own money! And you don't have to write a single ad. Tested and proven ads are prepared for you by experts. Reinvest the profits from your first successful ad —to get more, larger ads, and the profits begin to snowball! It's like building a chain of stores . . . each new store puts more money in *your* pocket.

You mail out beautiful catalogs which offer hundreds of dollars worth of fine, quality gifts—yet you don't invest one cent of *your* own money in merchandise! Your catalogs are printed with your name and address, so all orders come to you. Everything is "drop-shipped" for you, and there's up to *100% mark-up!* You pocket the cash profits immediately—even before the orders are shipped to your customers!

The thrill of receiving money in your mail is one you'll never tire of!

Repeat orders alone, just from mailing catalogs, could bring you a steady income for the rest of your life!

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A recent feature article in Income Opportunities Magazine stated, "Mail Order Associates Inc., offers the most comprehensive Mail Order program ever offered to beginners." They go on to say, "This could be the opportunity you've been looking for. A chance to get in on the ground floor in a little-known business which we believe is on the verge of a new boom."

Free

We are now accepting a limited number of charter members in our new Mail Order Program. No previous experience is required but you must be over 21.

If you are sincerely interested in starting a profitable business of your own . . . if you can see the tremendous advantages which Mail Order offers . . . then ACT NOW!

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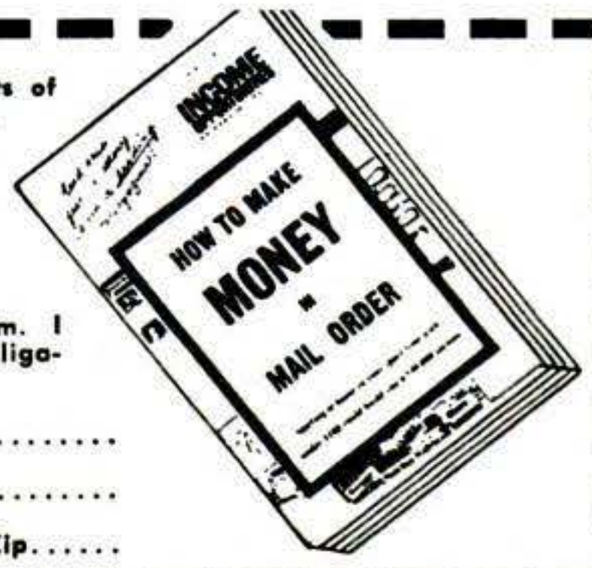

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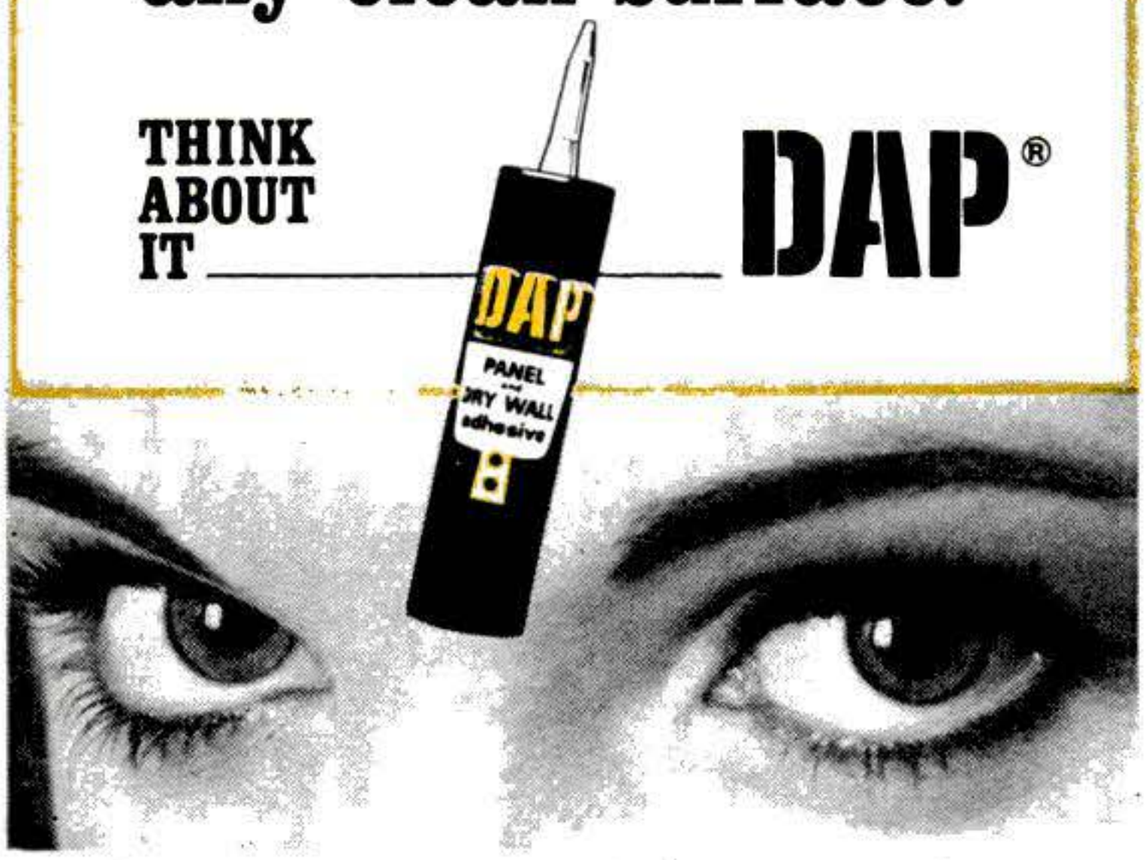

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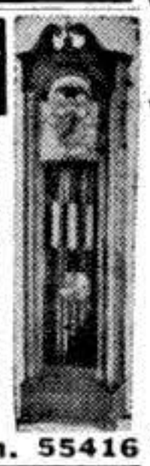

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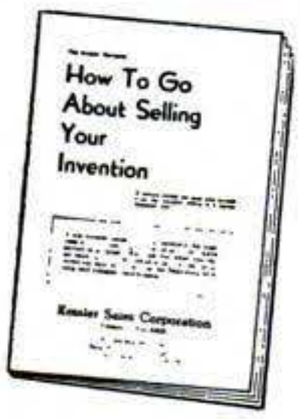

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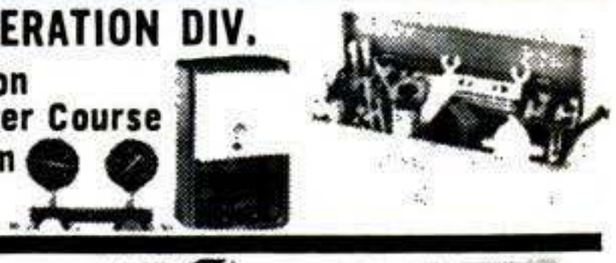

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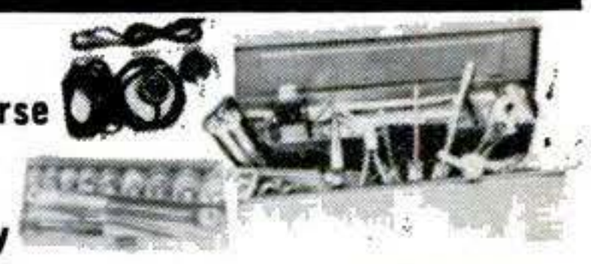

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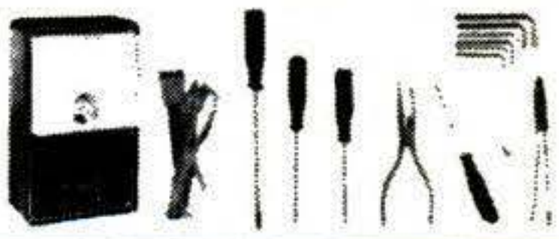

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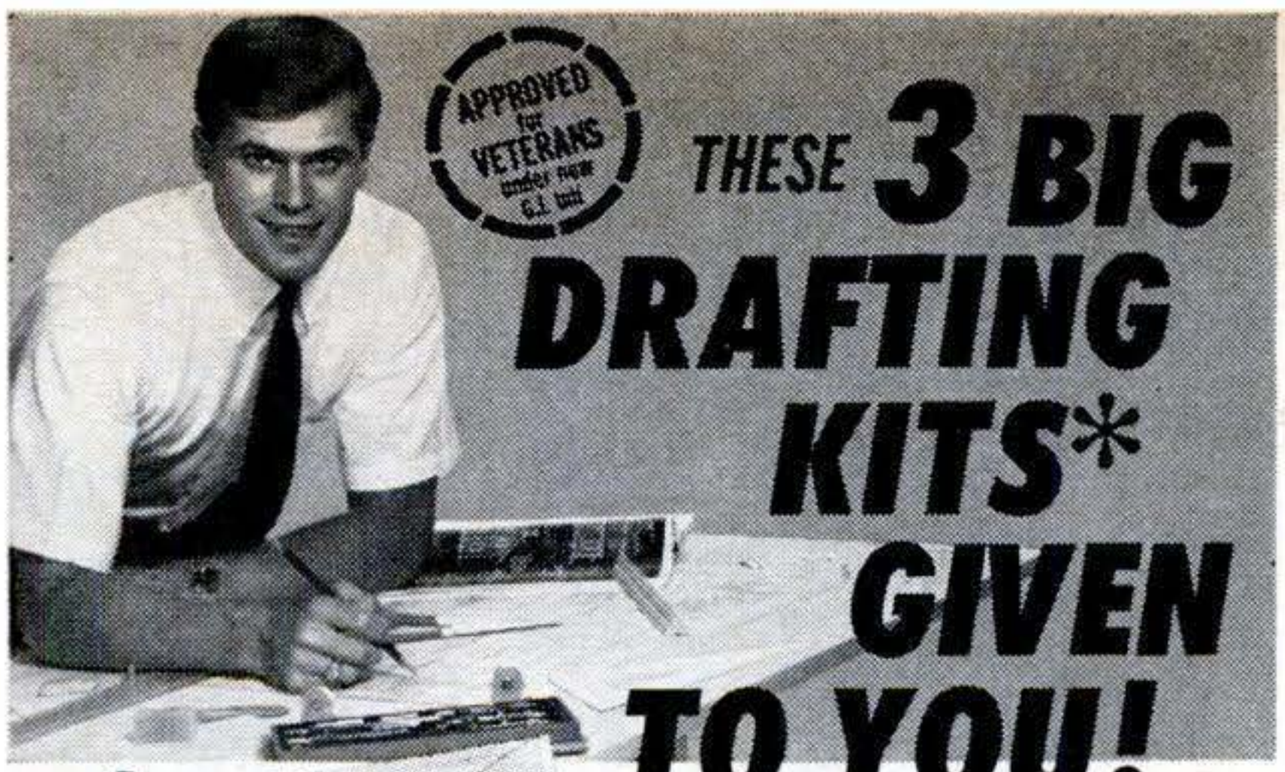

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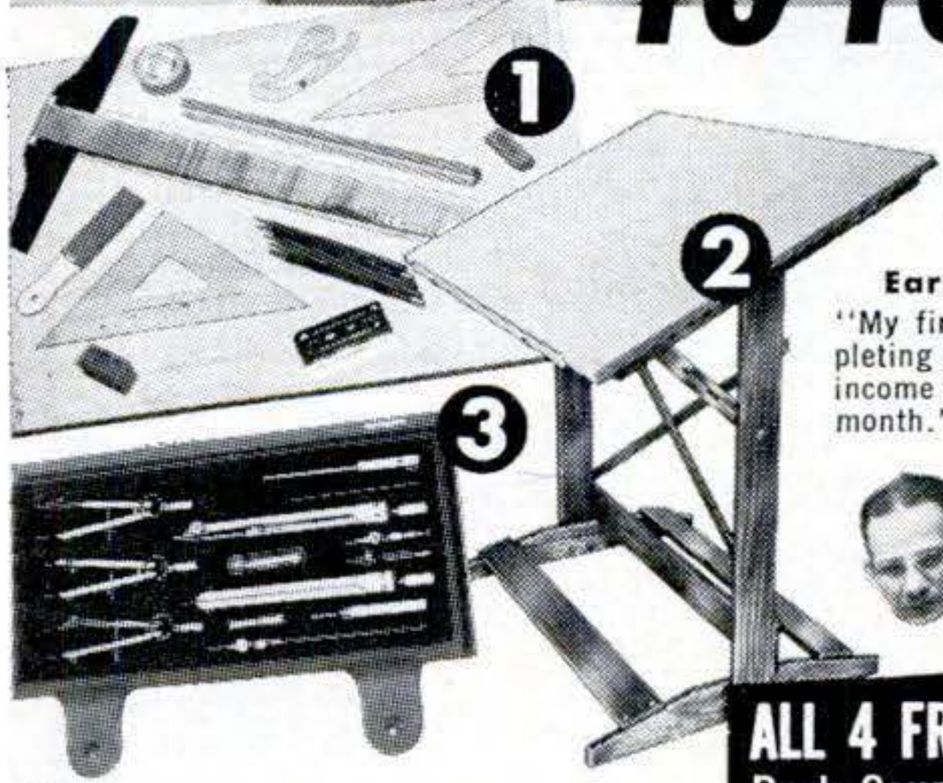

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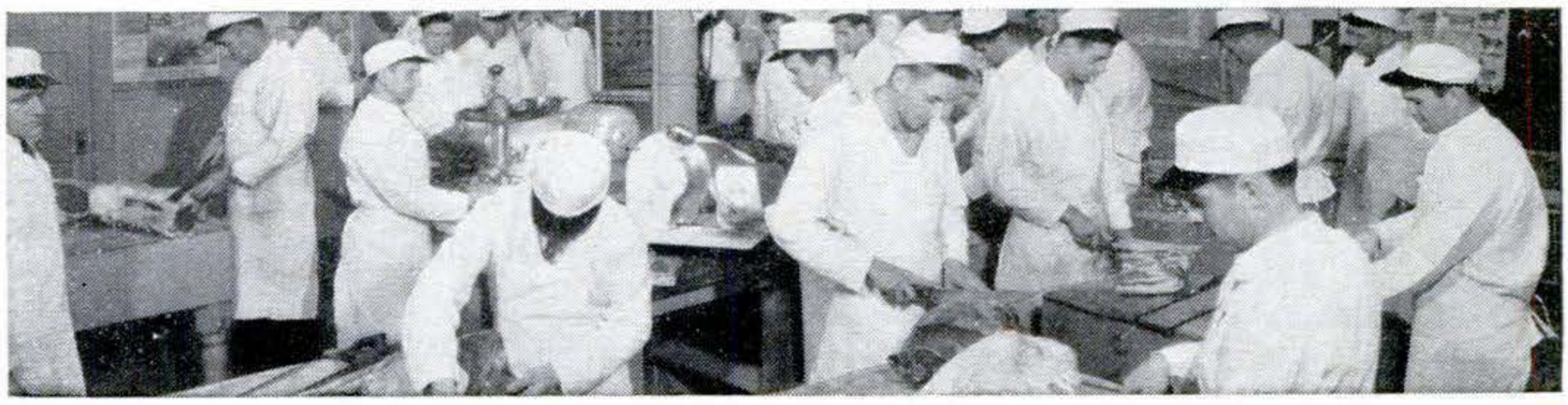

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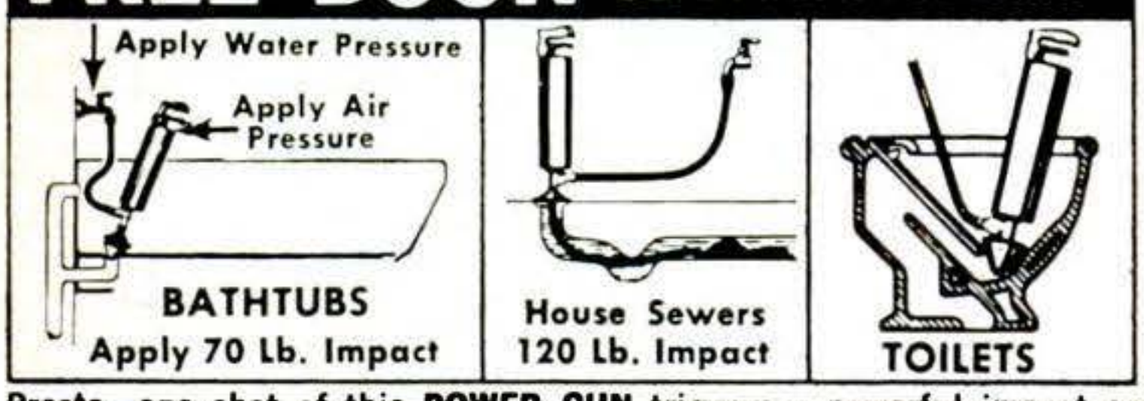

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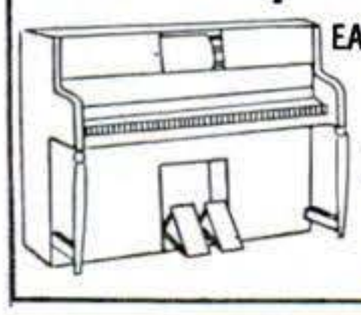

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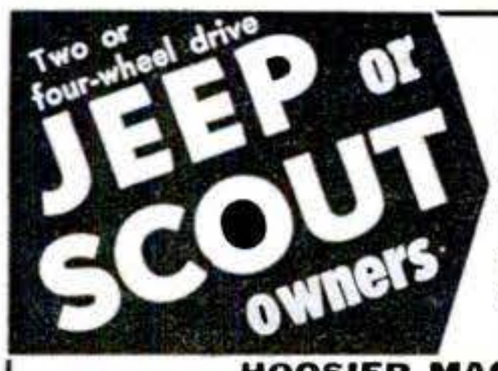

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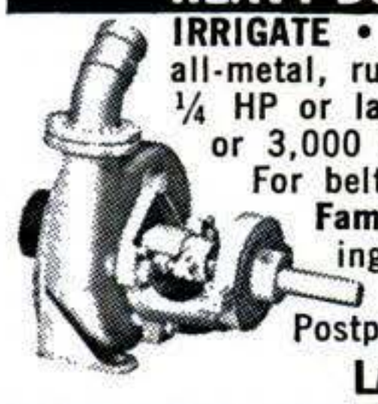

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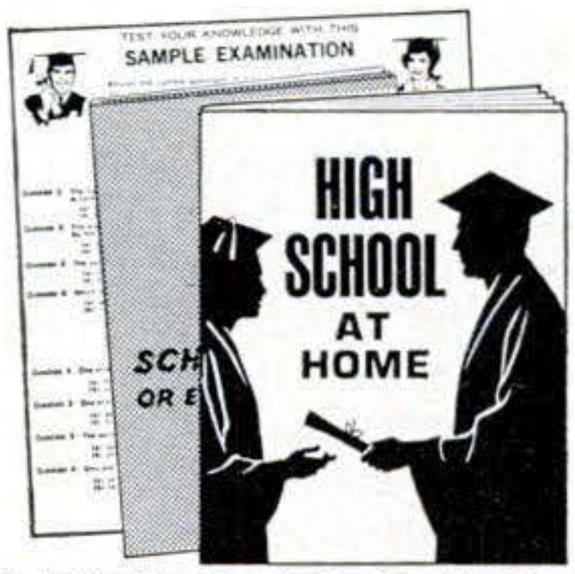

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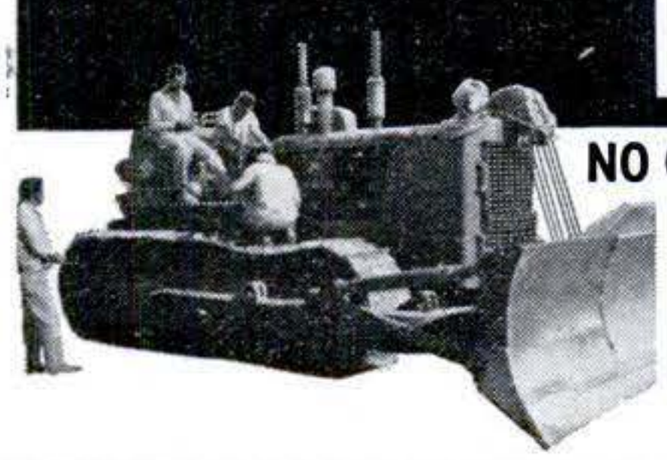

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Detroit Report...

WHERE IS CHRYSLER'S ELECTRIC CAR? The announcement of American Motors' electric research vehicle leaves Chrysler the only big auto maker without an electric-car project. Ford and GM are now building their second-generation models. A full-size version of Ford's new exotic battery car will be unveiled within six months. GM has two new electrics in the works. One is a hybrid design with two power plants--gasoline engine in front, electric motor in the rear.

Electric cars will not solve smog problems. So concludes a blue-ribbon panel making a study for the U. S. Department of Commerce. This takes the urgency out of the development of electric cars for city use. After months of study, the experts said that the proposed electrics will have no significant effect on air pollution. Biggest reason: Detroit success in meeting the exhaust-emission control standards set for gasoline engines.

What's holding up skidproof brakes? Detroit has clamped a tight lid on antiskid progress reports to the public because they are not yet satisfied with the systems they are testing. Public interest is sky-high in brakes that promise to keep a car steerable on ice even if the brakes are jammed on. And the car makers know that the demand may become too great to hold off another year if the public is told that antiskid brake systems are ready for production. What's worrying Detroit about rushing ahead is the possibility of a faulty system. Some of the units have a cut-off valve that actually stops all hydraulic pressure as part of the skid-prevention mechanism. If the valve should stick, all braking power could be lost.

Is Ford working on a steam car? Almost. As part of what the company calls a research program on all forms of power plants, Ford has a steam engine on order from a Pennsylvania steam-engine builder. The engine will be put in a full-size Ford sedan for testing. One problem that plagued old-timers is still puzzling steam engineers: How to get rid of the water that forms when hot steam condenses in the chamber of a cold engine. With sufficient condensation in cold-weather starts, the engine becomes a water pump. Power output drops and the machine may be damaged.

You'll drive on tires of the future soon. Several makers are aiming to bring out a tire combining the best features of radial-ply, bias-ply (conventional), and wide-tread construction before the end of the year. Production will be limited at first. Goodyear's "future" tire will be called Wide Tread Polyglas (it's made with polyester cord plies). New brand names will appear from the other manufacturers.

New Ford Econolines are coming. An all-new van and wagon type with forward control will replace the 90-in.-wheelbase Econolines. It will have a wheelbase of 102 inches and a mini-hood to improve leg room, and will provide space for heating and air-conditioning units up front. The mini-hood also allows a sharper rake for the steering column, giving a more comfortable driving position.

More U. S. engines are going abroad. Chevrolet is supplying Corvette engines to more than one European car manufacturer. The Italian-built Bizzarrini sports car has used Chevy power for two-three years; now the ISO company in Bresso, Italy, has built a Corvette-powered sedan that must surely rival the Maserati Quattroporte as the fastest four-seater in the world. Smaller Chevrolet engines are standard in Opel Diplomat models. Chrysler also has a good market for V-8 engines in Europe: Jensen and Bristol in England, and a new Swiss-made car, the Monteverdi.

Prices are down on British cars. On the tail of the devaluation of the pound sterling, you can now get a two-seater Sprite for $1,925, and an MG-B GT for $2,995. If you're *really* upgrading, Rolls-Royce has slashed an even $1,000 off the Silver Shadow—it's now only $19,600.

Jim Dunne

Detroit Editor

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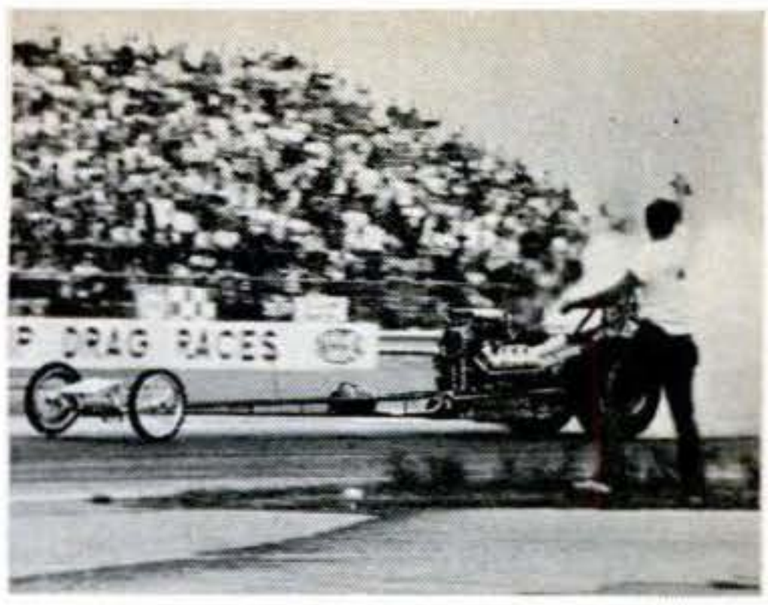
Champions spark Ferrari to World Sports Car Manufacturers' Championship

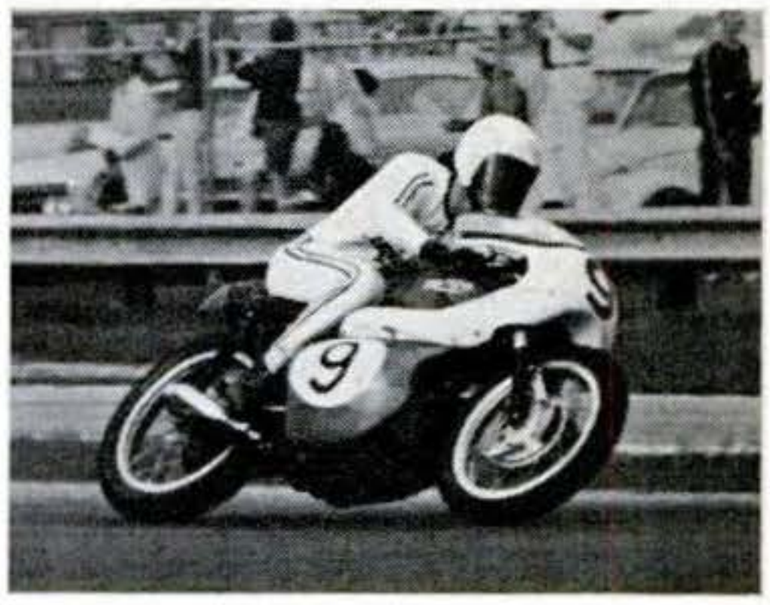
Champions spark Richard Petty's Plymouth to NASCAR Grand National Championship



Champions spark Don Garlits' Dodge-powered dragster to NHRA Nationals Top Eliminator

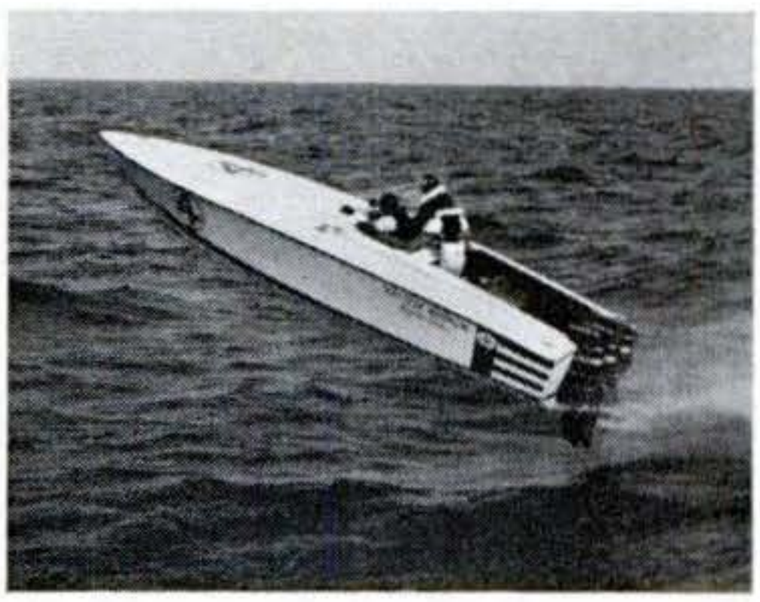
Champions spark Gus Hutchison's Lotus-Ford to SCCA Grand Prix Championship

Champions spark Denny Hulme's Repco-Brabham to World Grand Prix Driver's Championship

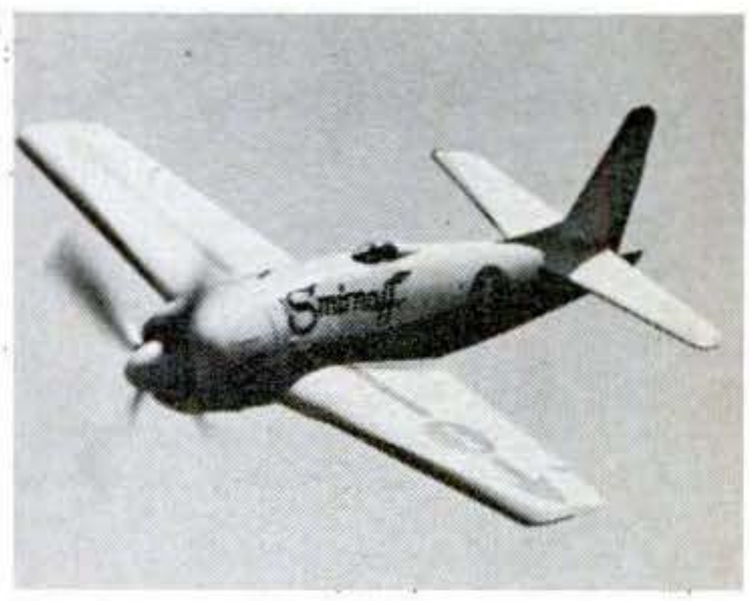


Champions spark Gary Nixon's Triumph to AMA Grand National Championship

Champions spark Mark Donohue's Sunoco Special Lola-Chevrolet to SCCA's U.S. Road Racing Championship



Champions spark Don Aronow's Mercury-powered ocean racer to Union of International Motorboating World Offshore Driver's Championship



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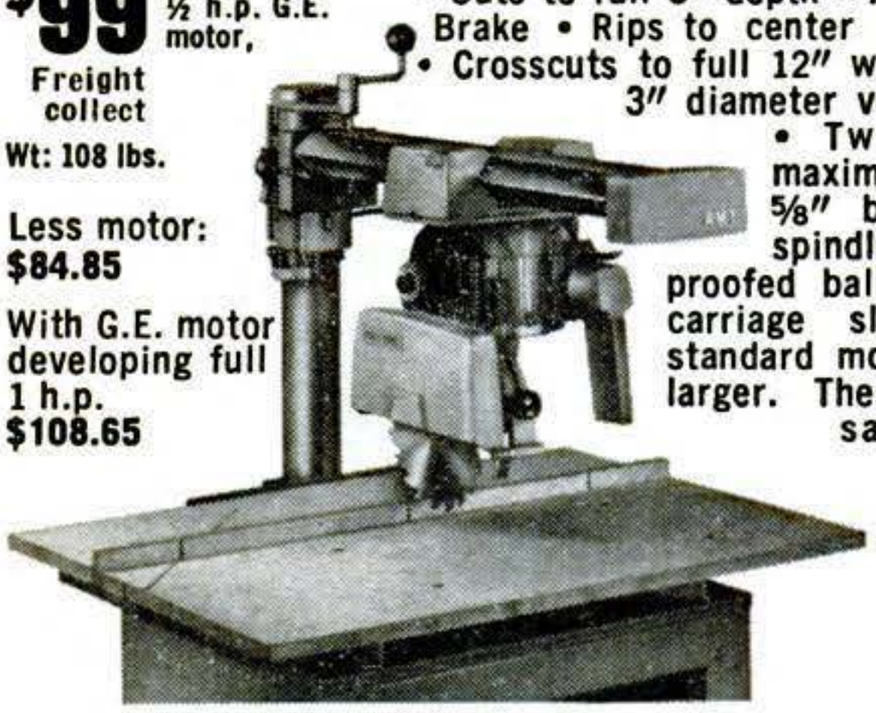

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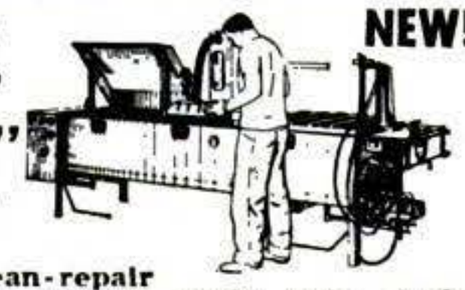

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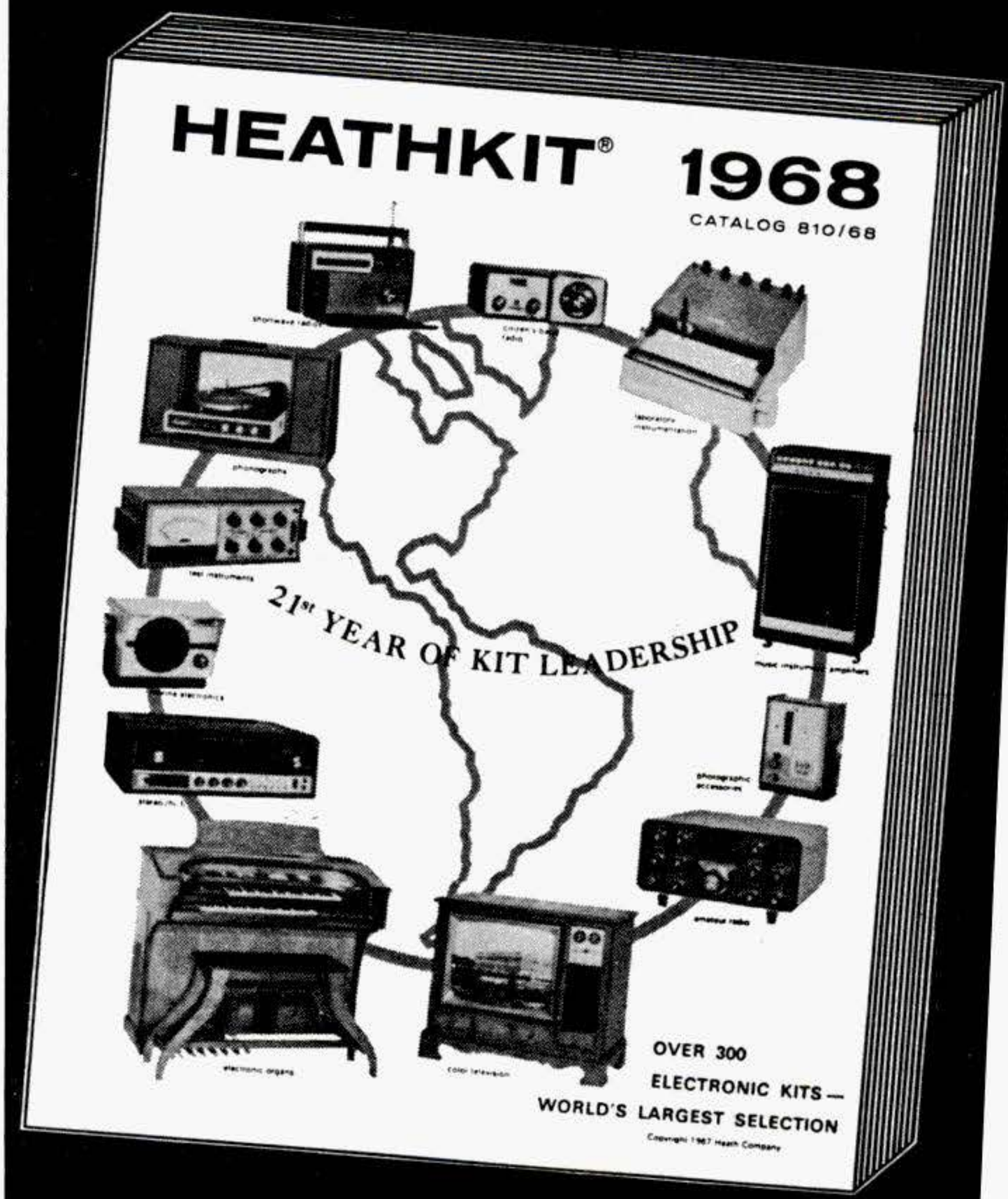

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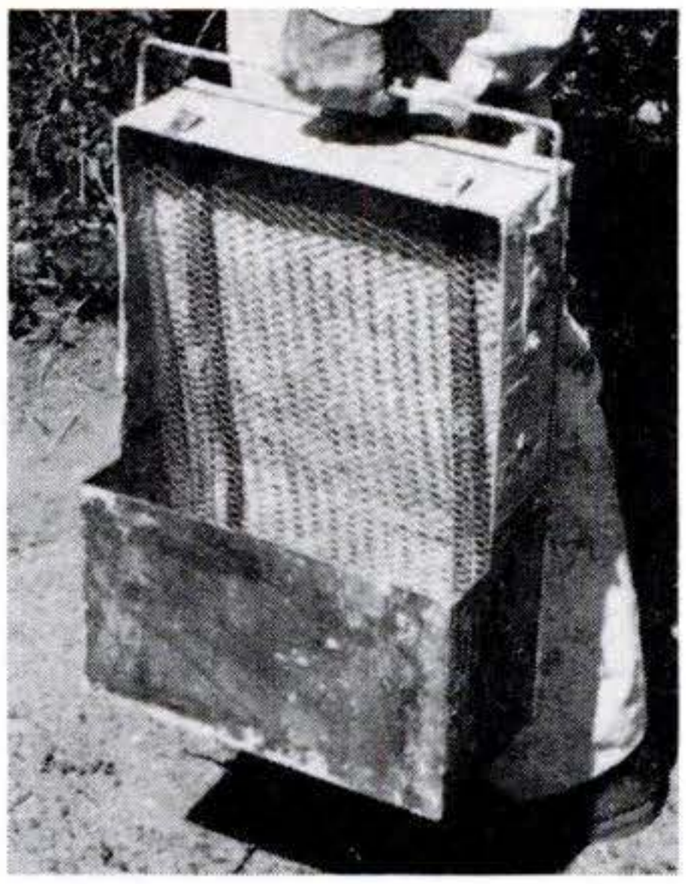
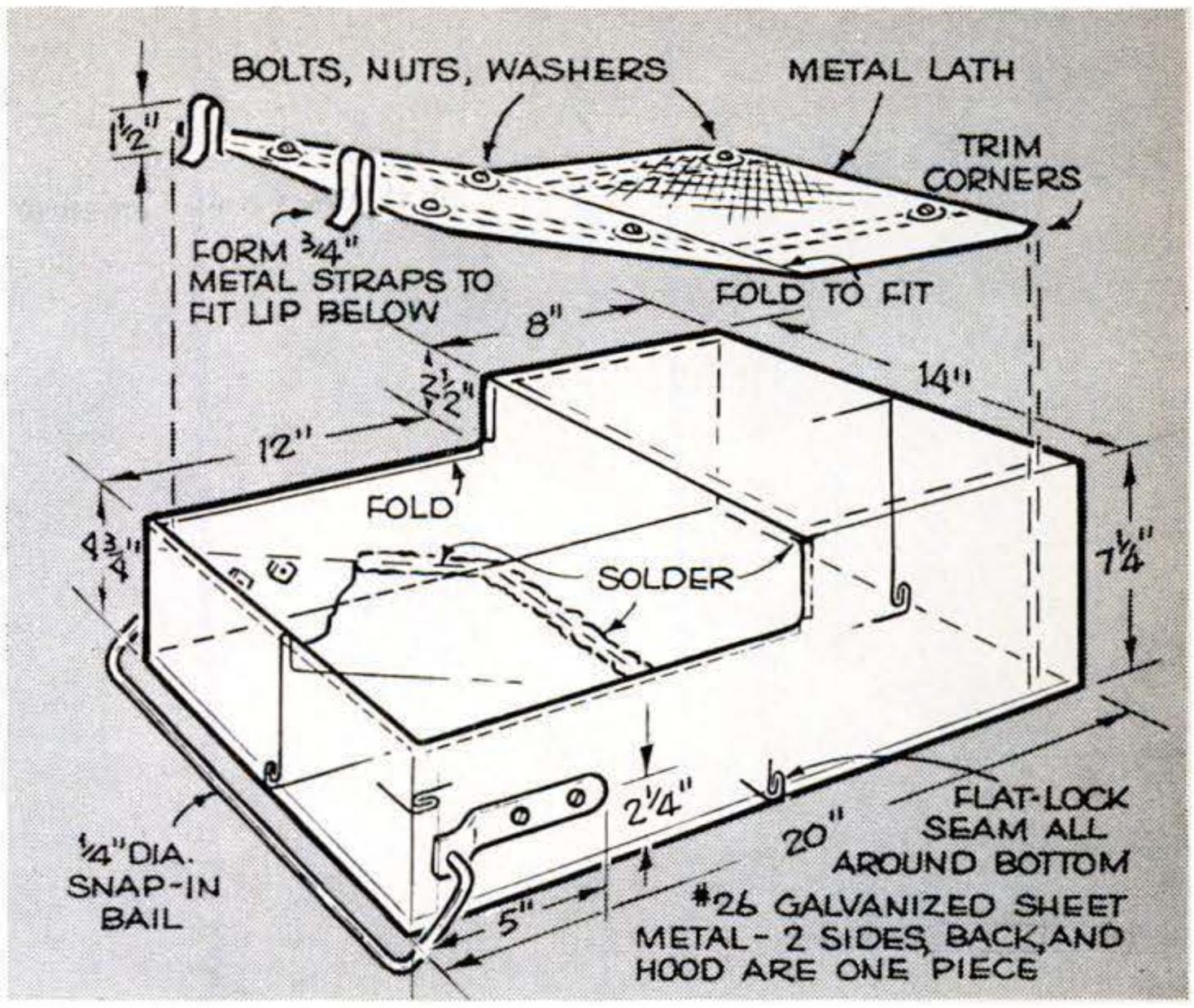
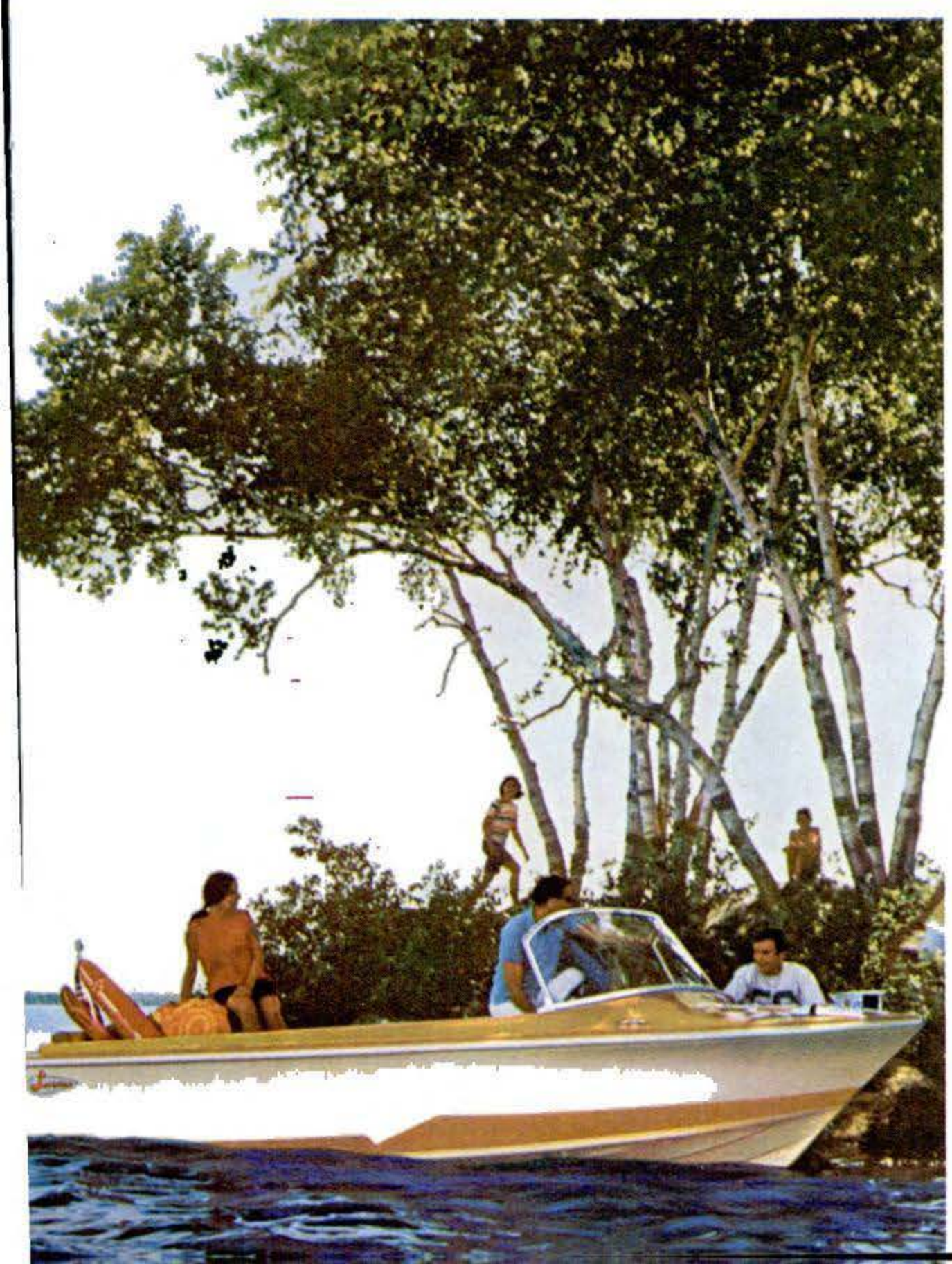




Paint tray with a built-in bucket

Make this tray-bucket and you can carry a healthy amount of paint in one hand for big outside jobs. The wire mesh assures even paint distribution on rollers; since it's removable, cleanup is simple. Solder all joints and fold tabs on any exposed edges for safety. Use water to test tightness before loading up with paint.

CLINT CARTER, Santa Fe, N. M.



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Yellow Pages

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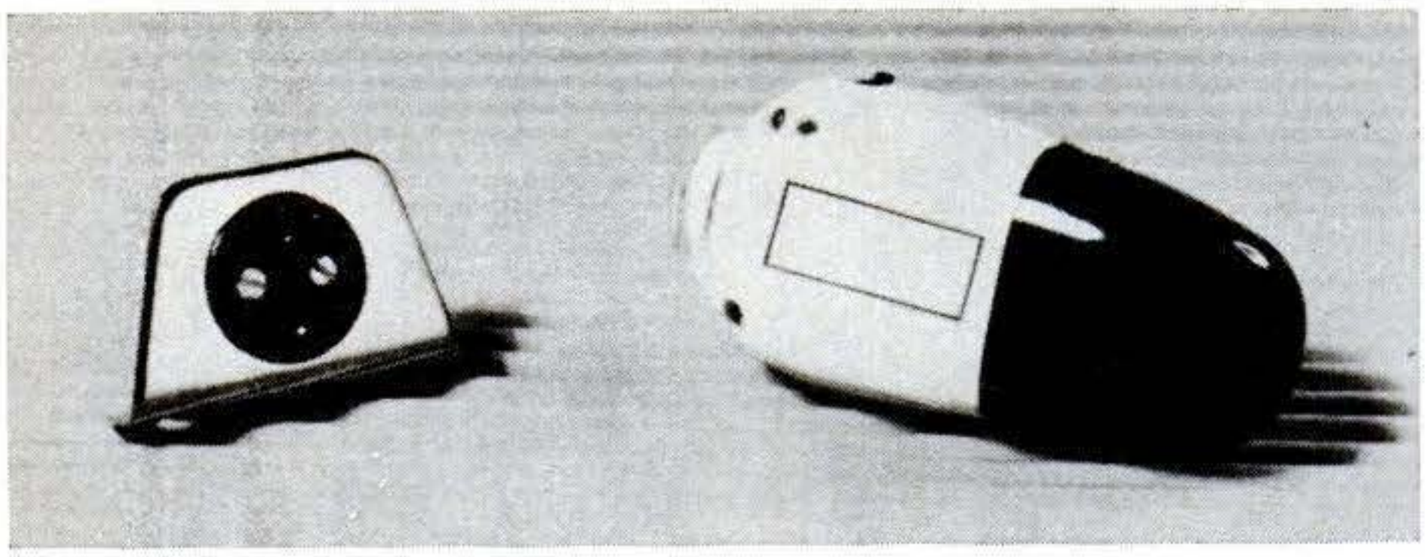
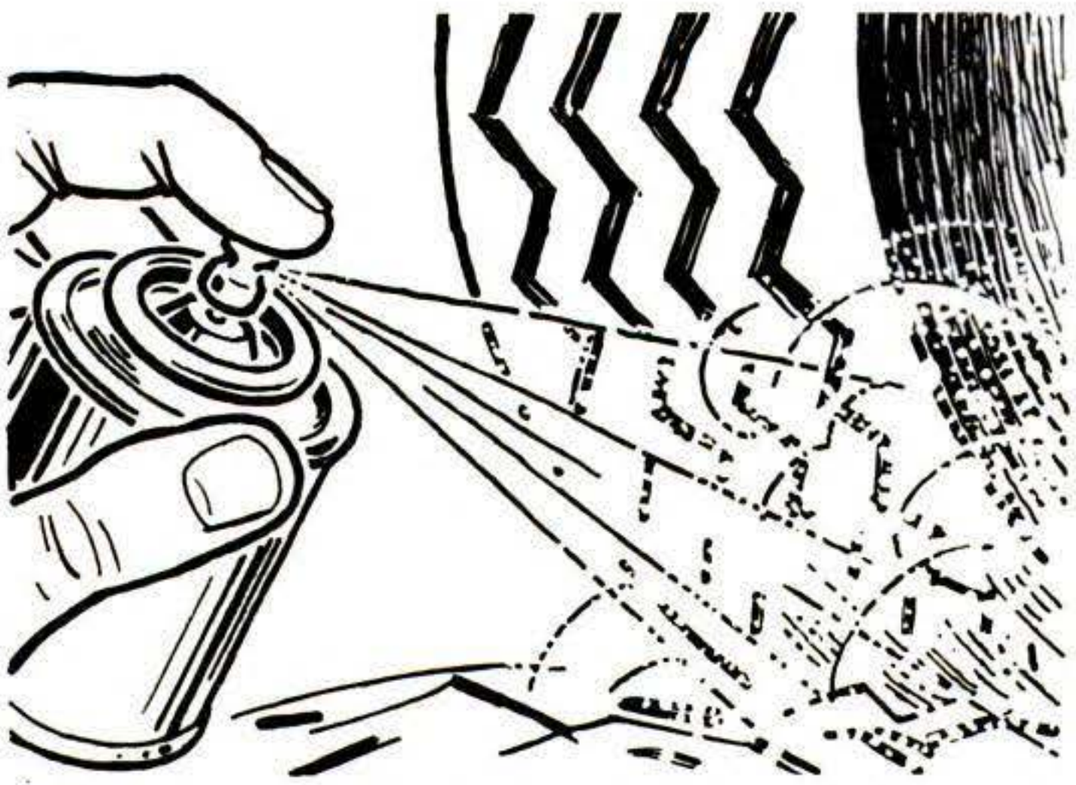
Start and warm up your car by remote control

This little radio unit sends signals to your car, and lets you start it in your driveway or in a parking lot up to 500 feet away. It also enables you to operate heater and air-conditioner controls. The unit, named Ramostar, can be set to shut off the engine after five to 15 minutes, and will warn you if anyone is trying to tamper with your car. It has 32,338 different code combinations. Prices from Ramostar, 708 Waukegan Road, Deerfield, Ill. 60015.



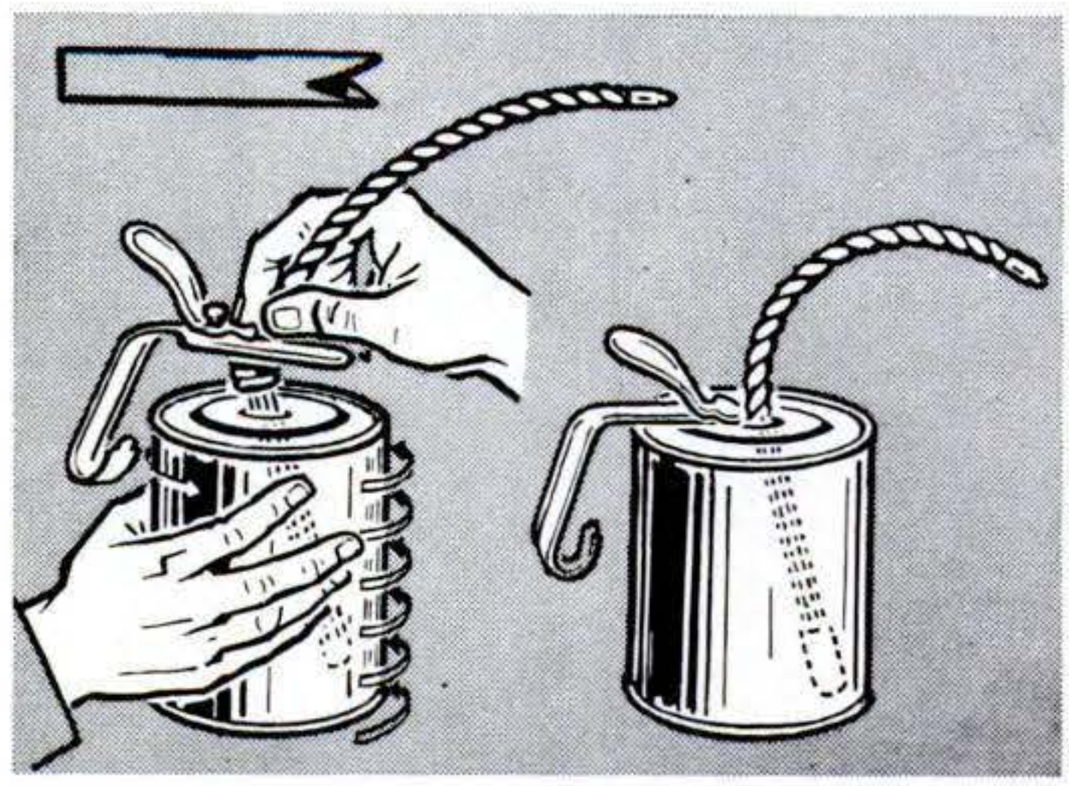
Rechargeable car flashlight

Thanks to two nickel-cadmium batteries, this flashlight is completely dry and sealed for life. Recharging socket for it is easily installed under the dash. $5.50 from J. C. Whitney, 1917 Archer Ave., Chicago 60616.



Help for cars stuck in snow or ice

Spray this traction-improving chemical on your tires, spin wheels briefly, wait a minute, and drive out. Aerosol can fits in glove box. Use it on your shoes, too. It's made by Dow Chemical Co., Midland, Mich. 48640.



Portable oiler fits standard can

A new oiler comes with a ⅝-inch punch for piercing a mounting hole in the lid, a handle with pump mechanism, and an eight-inch spout. $2.95, Laurel Mfg. & Eng. Co., 150 N. 6 St., Connellsville, Pa. 15425.

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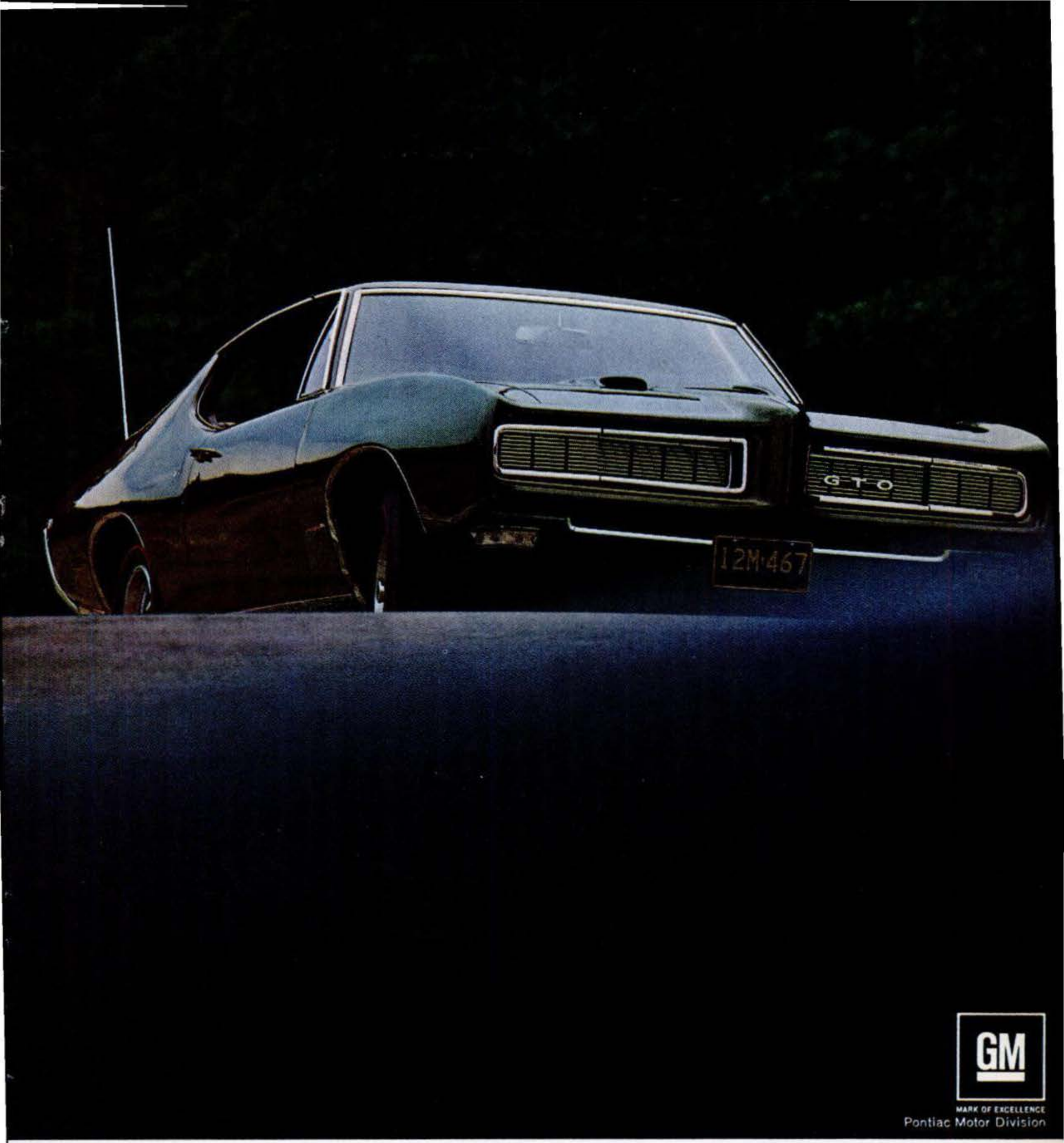

The GTO's new bumper is so fantastic you can't even see it.

It seems that everything our engineers touch turns to great. Last year, they made wipers disappear. This year, the most unique bumper since the invention of the bumper.

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The result? A bumper that not only is color-keyed to the car, but also resists minor chipping, peeling and corrosion. There are, however, some people who have to kick the bumper before they'll believe it. If you're one of these, go ahead. Kick the bumper. When you find it.

Specs, decals and 5 color pictures are yours for 30c (50c outside U.S.A.). Send to: '68 Wide-Tracks, P.O. Box 888I, 196 Wide-Track Blvd., Pontiac, Michigan 48056.

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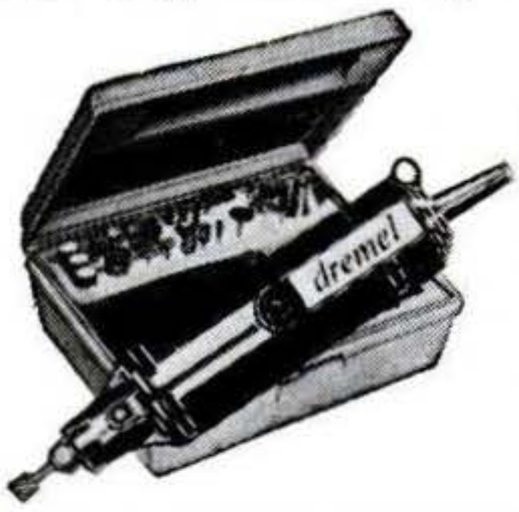

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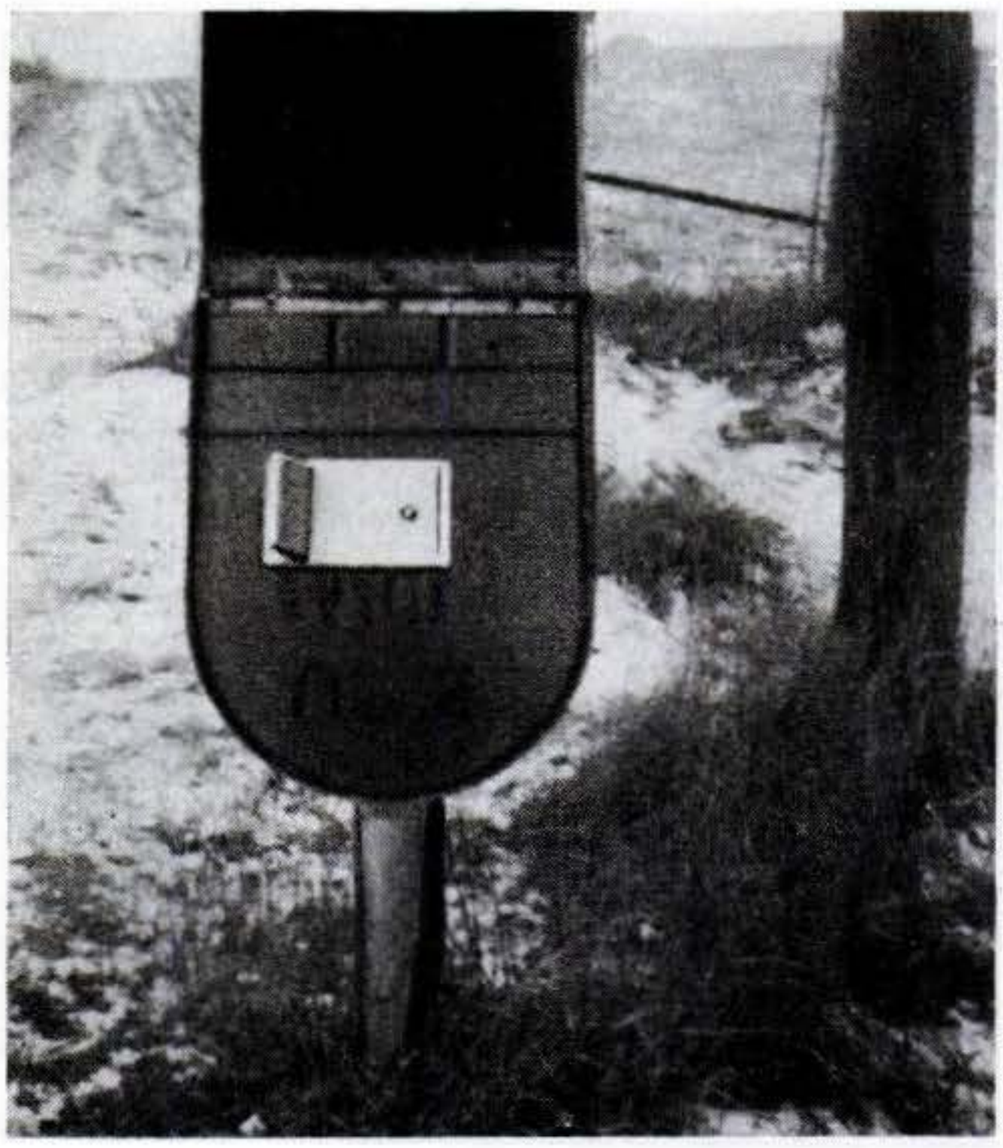
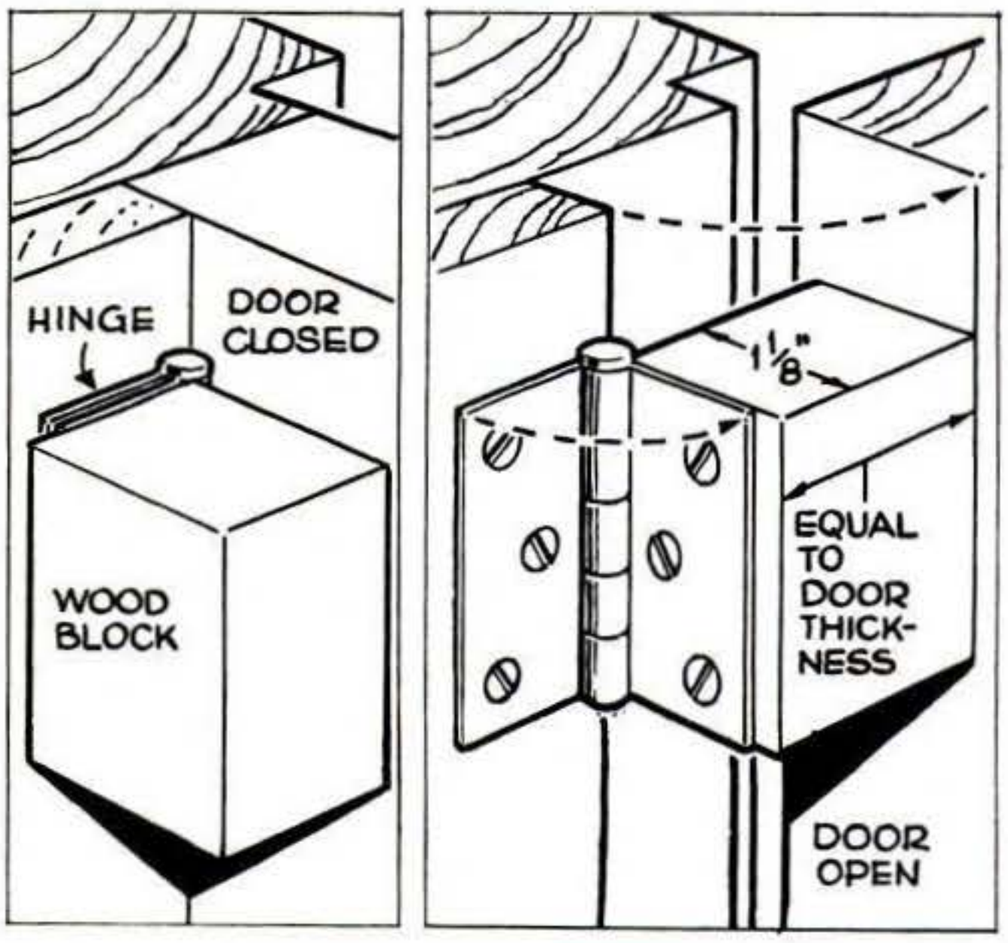


Clipboard on mailbox holds letters

When the mailman opens the mailbox, wind often scatters outgoing mail. Mounting a small clipboard on the door holds the letters and makes them windproof.

OWEN SOLOMONSON, Scarville, Iowa



Hinged doorstop saves doors

Heavy gusts of wind can slam a door hard enough to shatter glass and your nerves. Try hinging a block of wood to serve as a stop when the door is opened. It also saves searching for a stick, or prop, every time you want to hold the door open.

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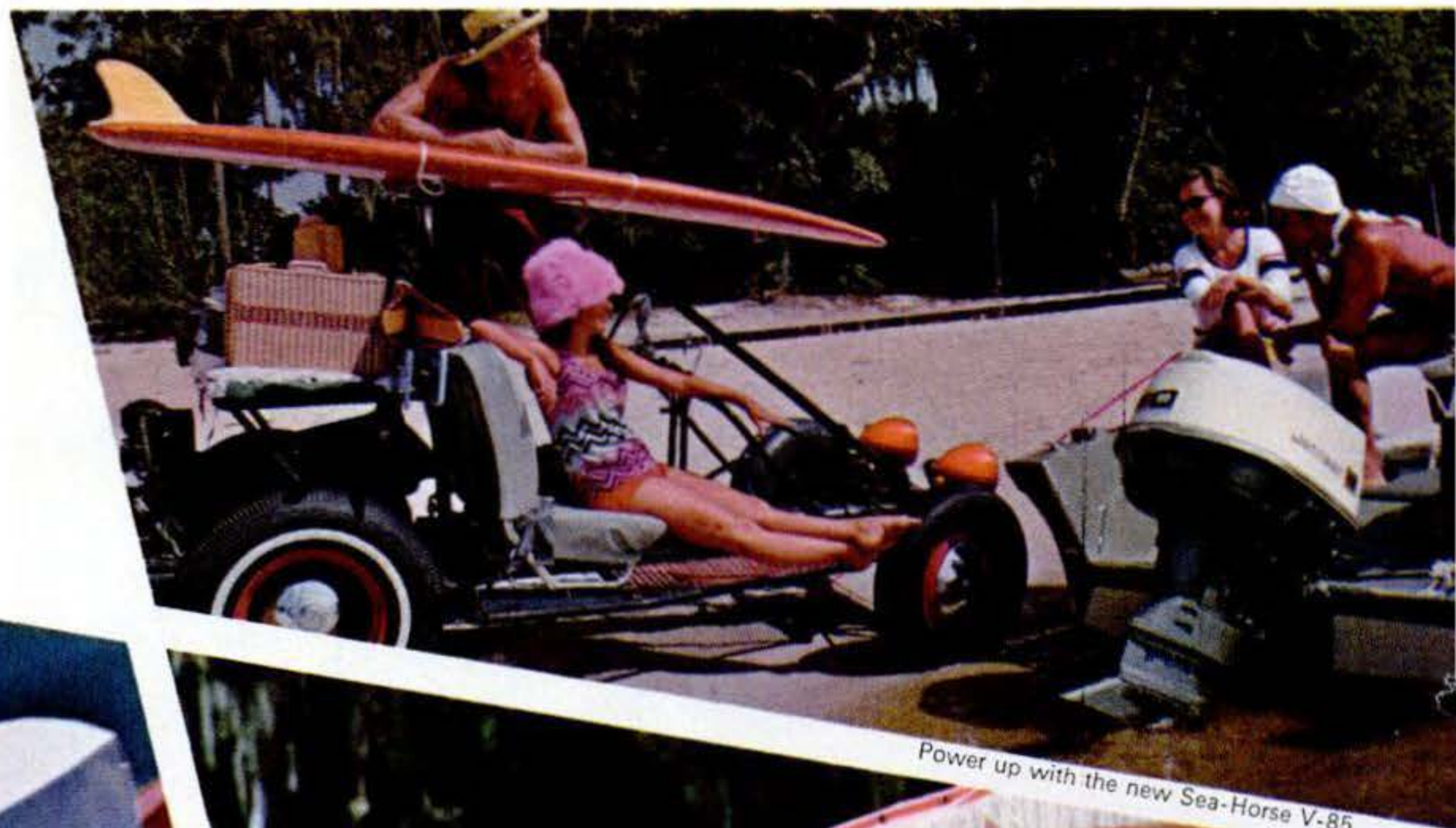

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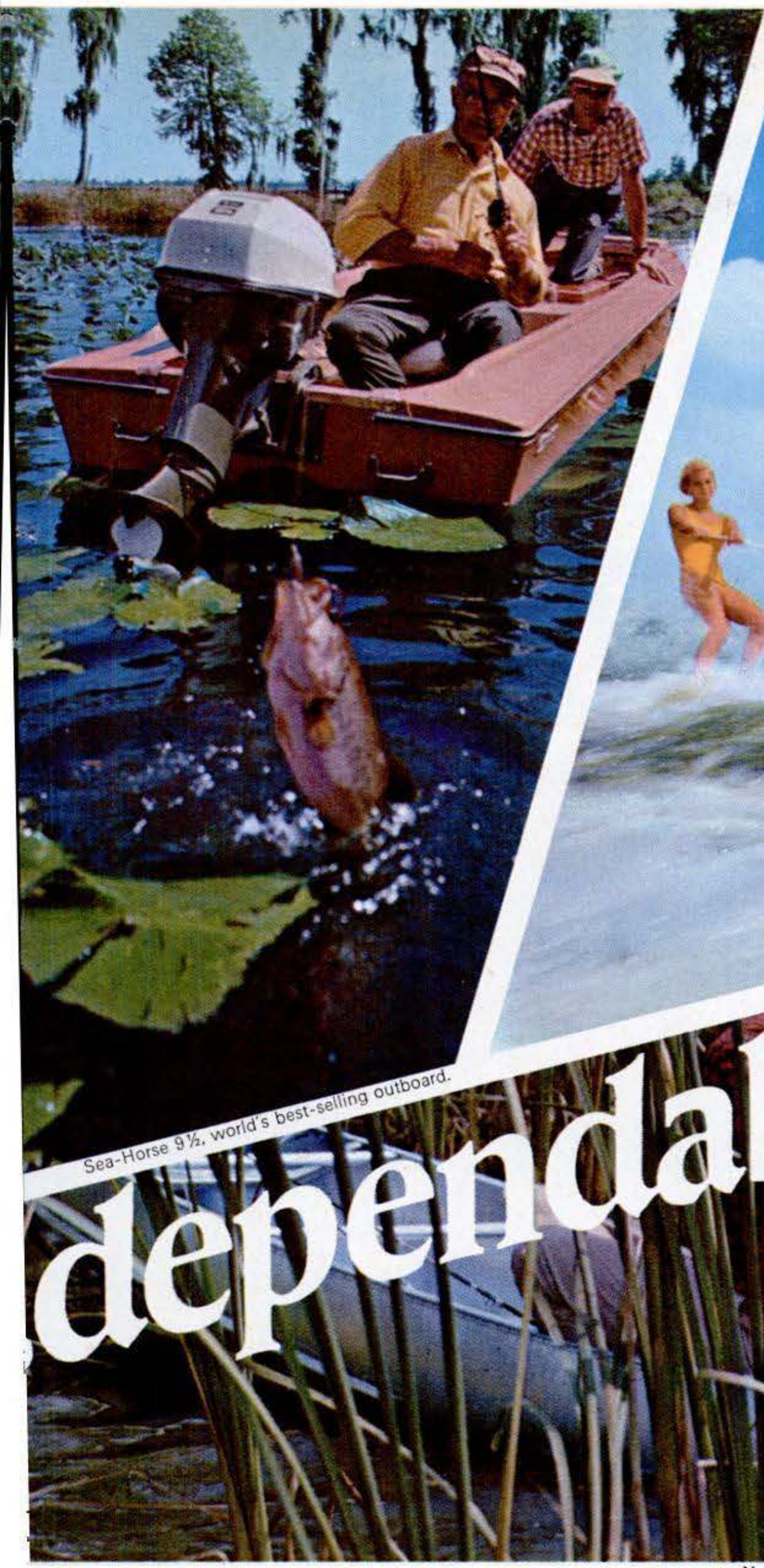

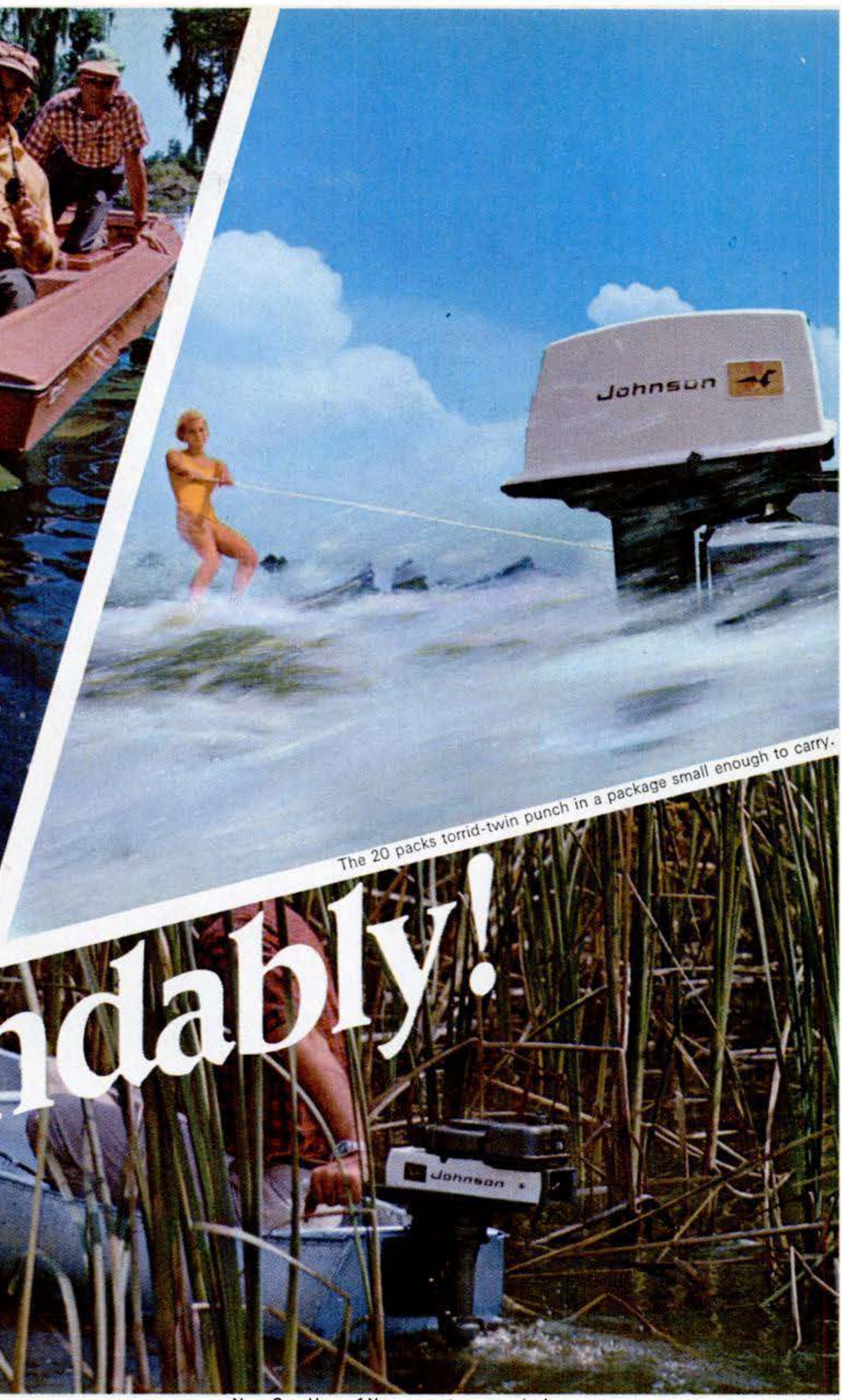

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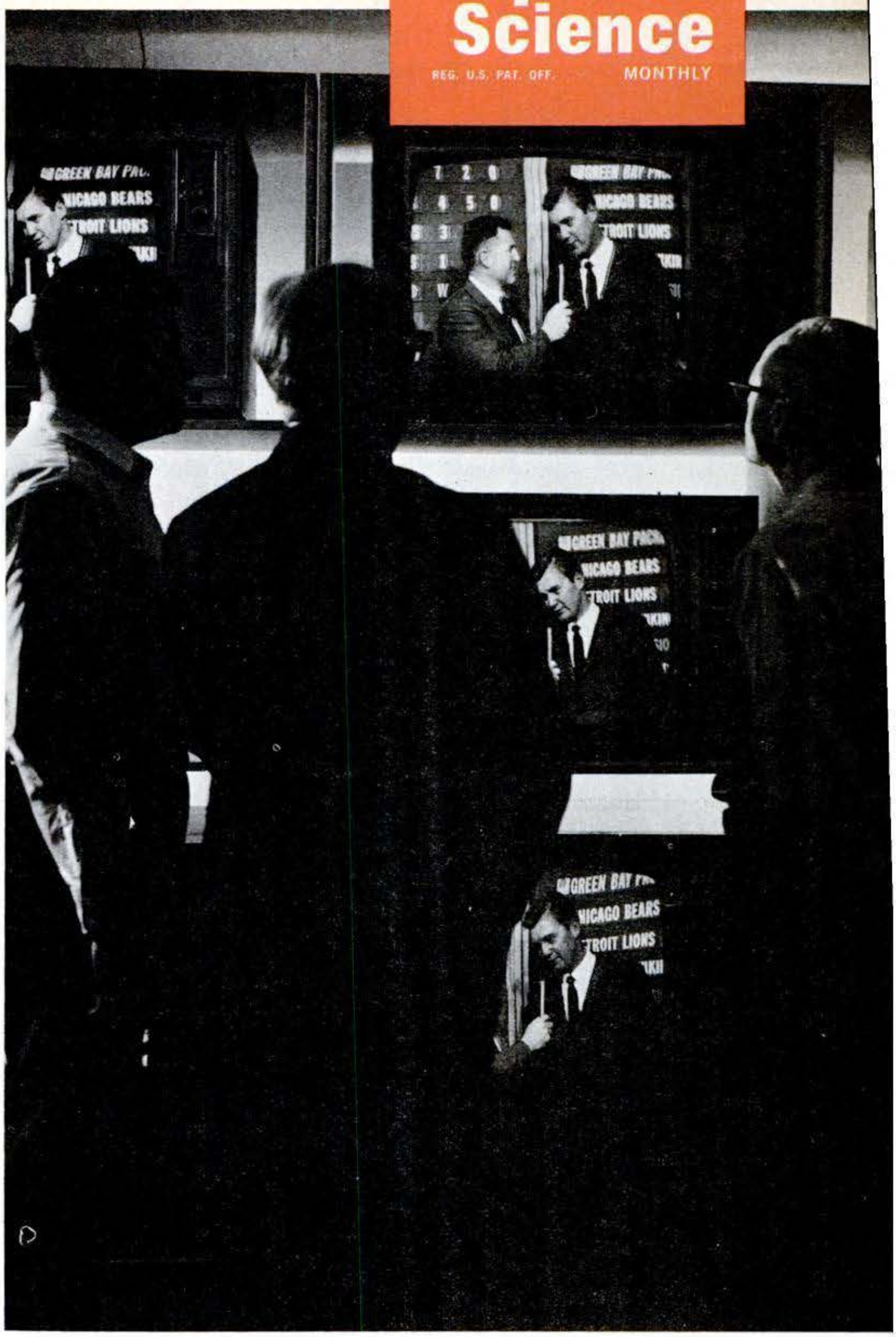
Your Buyer's Guide to the TOP 10 COLOR TVs

Who makes the best color TV? The only sure way to find out is to gather up a warehouseful of the latest models, plug 'em in, and compare the pictures. And that's exactly what PS did. Here are the results of the most extensive color-TV viewing tests ever conducted by a magazine



By RONALD M. BENREY
PS Electronics Editor

THE SETS More than 20 U.S. firms manufacture color TVs, but 10 of them—the "Top 10"—produce over 90 percent of the sets sold each year.

But who are the Top 10? Although TV manufacturers keep their sales figures confidential, it's an open secret that individual brand-name sales fluctuate widely from month to month. And so we invited *11* manufacturers—the 11 shown on the next page—to submit sample sets for our survey. In our judgment, all are potential candidates for the exclusive Top 10 club.

Our tests were aimed primarily at judging color-picture quality. Our most important "test instrument" was a six-member jury who evaluated the 11 color pictures in a specially equipped viewing room. I'll say more about this shortly.

We were not concerned with elaborate cabinetry or electronic frills such as remote control, and we required that each set be the simplest available color TV that contained the manufacturer's top-line big-screen color chassis. We knew from past

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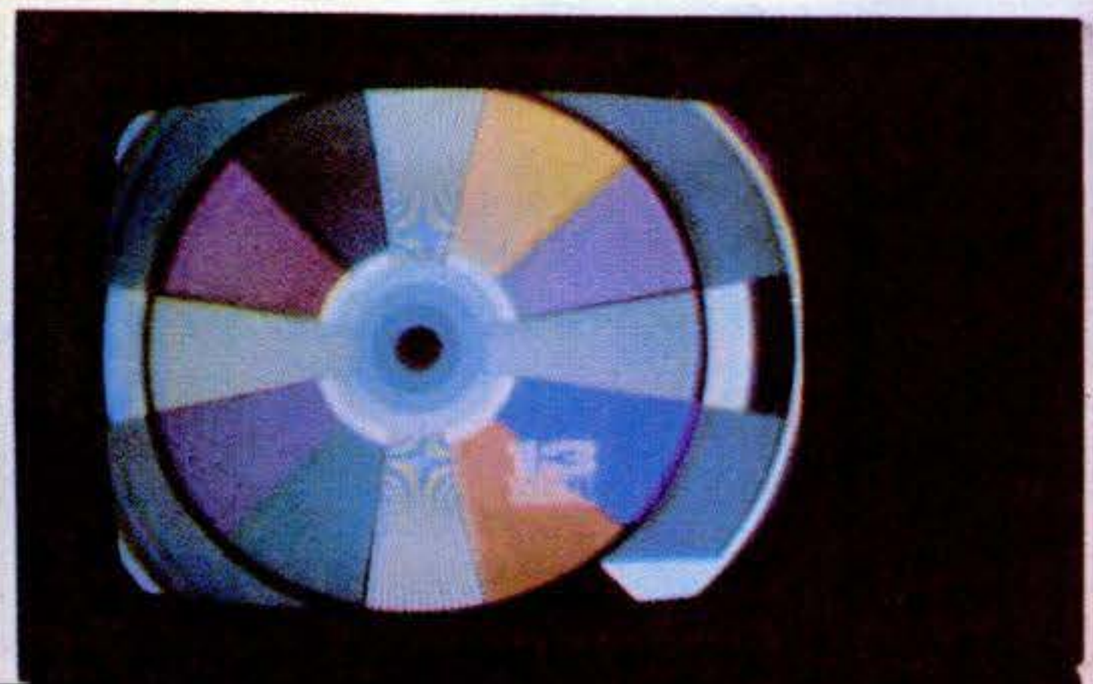
Our jury viewed the 11 color TV screens under near-ideal conditions, in r

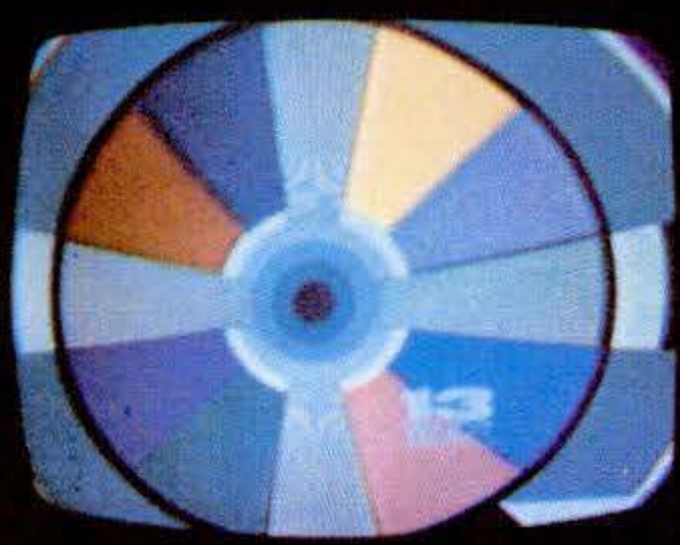
WESTINGHOUSE

ZENITH



GE

Inside the PS viewing room: This unretouched photograph shows the 11 sample TVs as they were arranged during the judging period. The sets are simultaneously receiving a conventional color test pattern broadcast by WNDT in New York City. The line-of-sight distance between the station's transmitting antenna and our receiving antenna was approximately 50 miles.



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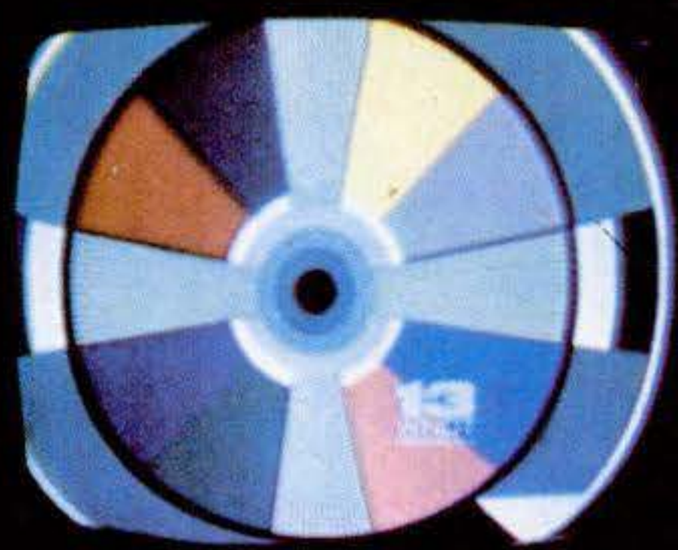

SYLVANIA

surveys that although every color-TV manfacturer produces scores of different models, he actually builds only one or two basic chassis. The "price range" column in the specification chart farther on tells the story: The most significant difference between the lowest- and highest-priced models in any manufacturer's lineup is in the quantity of fancy woodwork wrapped around the chassis.

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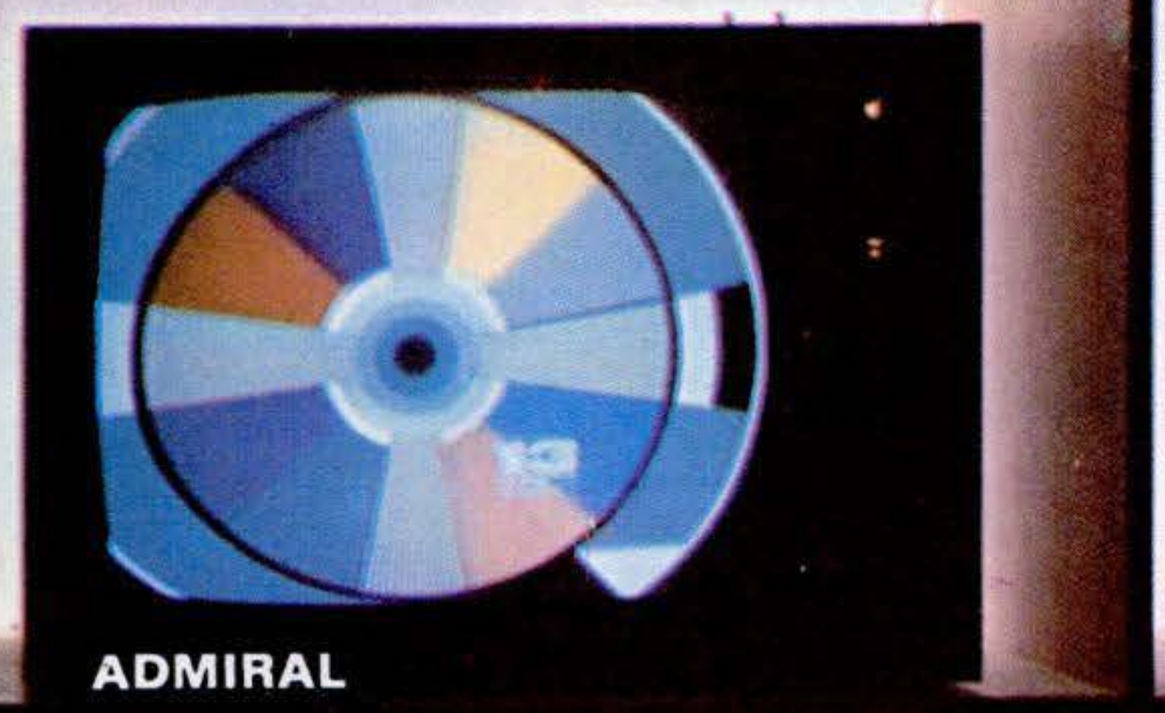
a specially equipped viewing room

SILVERTONE (SEARS)

RCA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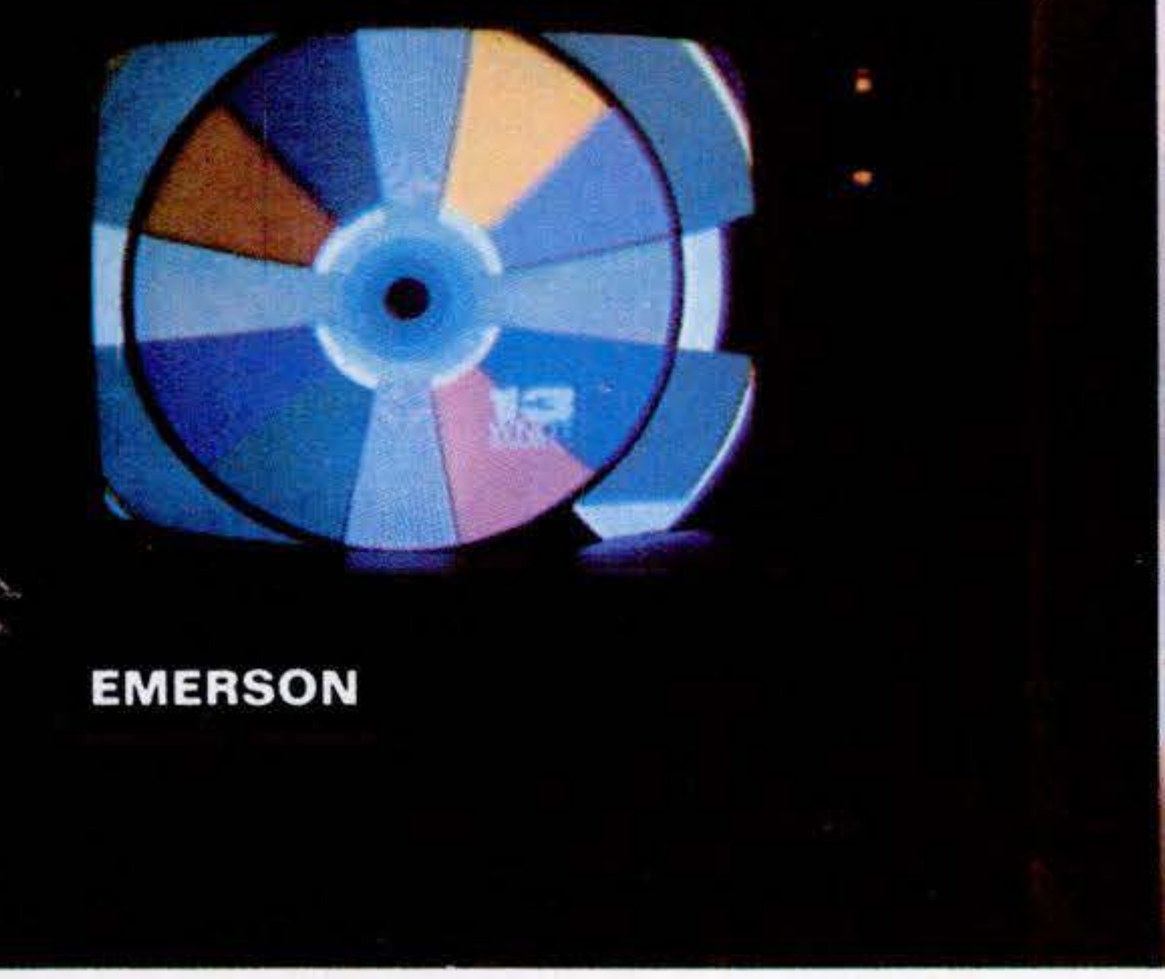
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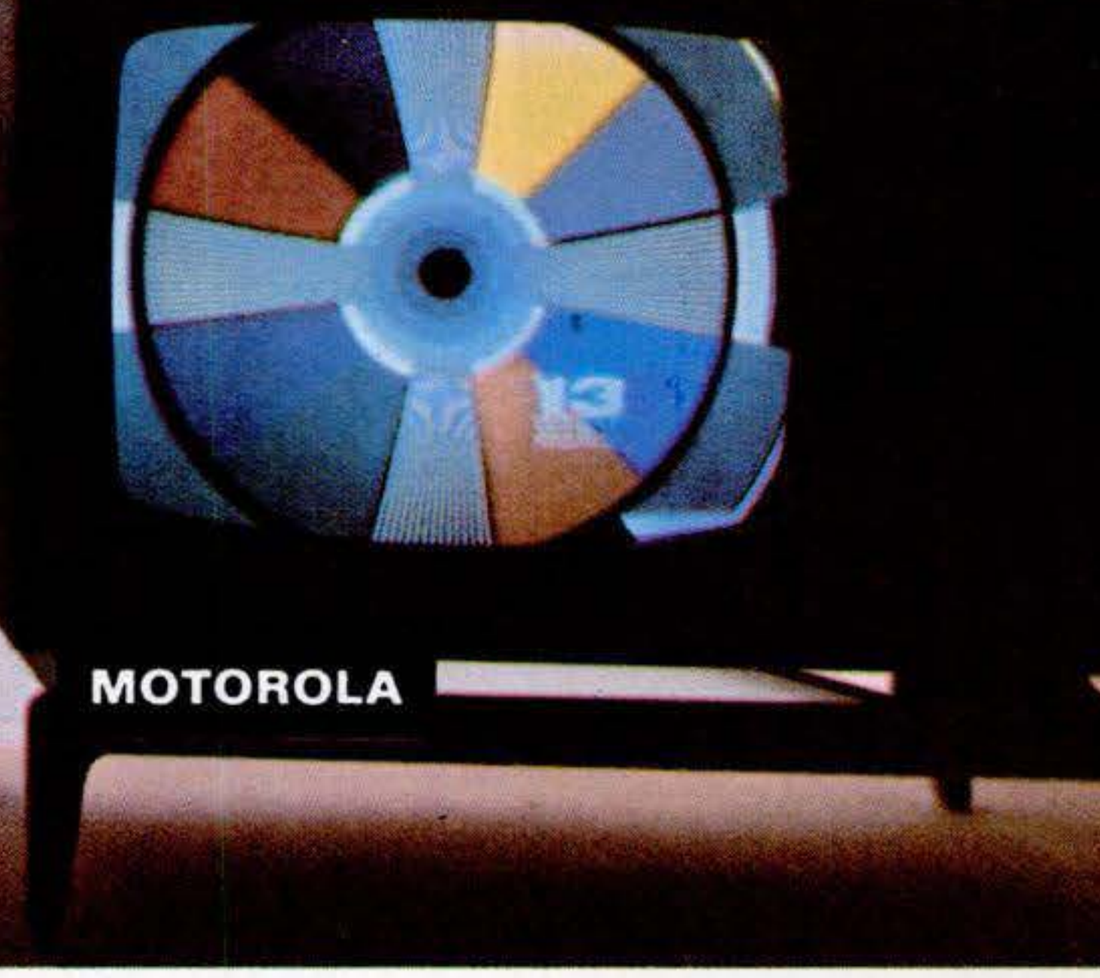
MOTOROLA

All 11 sets had 23-inch (295-square-inch) picture tubes — the largest available, and also the most popular big-screen color tube.

The TVs arrived at our test location packed in factory-sealed cartons. To the best of our knowledge all 11 were standard, off-the-assembly-line units that were in no way modified — or improved.

Continued

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Every manufacturer was invited to send a qualified service technician to install and adjust the sets prior to our viewing trials. All the sets required some adjustment, after they were unpacked, to clean up screen color impurity (off-color areas in the picture) and minor misconvergence (annoying color fringes in the picture).

THE TESTS We selected our jury carefully, to reflect both technically trained and ordinary TV viewers. The technical half of our team included a professional photographer, an art consultant and color expert, and an electronic engineer.

Our nontechnical members included a long-time color-TV owner and two persons planning to buy color sets this year.

The picture comparison was made under near-ideal viewing conditions. The 11 sets were clustered on a 14-by-seven-foot wooden shelf erected in front of a large paper backdrop. A bank of photographic flood lamps lit the backdrop uniformly. Backlighting all the sets simultaneously in this manner allowed us to establish a pleasing ambient light level around them without washing out the image on any of the screens, as front lighting would have done.

The sets were powered by three separate, individually fused 117-volt circuits. Voltage checks prior to testing verified that all 11 were receiving adequate line voltage.

We took special care to assure that a top-quality, equal-strength signal was fed to all sets. The tests were conducted on Long Island, approximately 50 air miles from the New York City TV-transmitting antenna complex atop the Empire State Building.

Our antenna was the latest JFD log-periodic Color Laser, mounted on an Alliance C-225 rotator. We precision-aimed the antenna with the help of a signal-strength meter.

Coaxial-cable lead-in and transmission line was used throughout our signal-distribution system to minimize electrical interference effects. During our viewing trials, the only visible interference was intermittent ghosting caused by passing airplanes.

The signal from the antenna was boosted by a Jerrold Gibralter broadband distribution amplifier—a professional unit designed to drive up to 40 TV sets simultaneously. The output signal from the amplifier was split 12 ways by a network of four JFD SC72-75 splitters. All unused outputs on the splitters were properly terminated with dummy-load resistors to prevent signal deterioration.

A JFD MT-56 matching transformer was mounted on every set—except the GE, which has a built-in transformer—to match the coaxial cable's 75-ohm impedance to the TV sets' 300-ohm input impedance.

A signal-strength meter check verified that all 11 sets received equal strength signals at the time of our viewing trials.

In our tests, each set was judged on the basis of 10 specific characteristics, and a point score was given for each characteristic. The maximum possible score differs among characteristics to reflect their relative importance in producing a top-quality color picture. The 10 characteristics:

- Color quality. An overall rating of a set's ability to create a natural-looking color picture. Our jury looked at a wide range of subjects, from panel shows to football games, before they passed judgment. Maximum score: 20 points.
- Apparent resolution. A measure of the fine detail within the picture. We were looking for more than sharpness or good focus—every screen displayed a razor-sharp, perfectly focused image, but the degree of fine detailing varied considerably from set to set. Maximum score: 10 points.
- Screen brightness. We adjusted each set to produce the brightest possible good color picture, and then compared the brightness levels of pure white areas on the 11 screens with a Honeywell one-degree spot photometer. Maximum score: 10 points.
- Tonal range. This is the range of tones—varying from light to dark—of any specific color that a set can reproduce. Wide tonal range throughout the color spectrum permits the TV image to show subtle details within very bright and very dark areas, enhancing the sensation of depth. Maximum score: 15 points.
- Ease of color adjustment. A color TV has two controls not found on a

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SPECIFICATIONS OF THE 11 COLOR-TV CHASSIS TESTED BY PS

ANUFACTURER	CHASSIS NUMBER	PRICE RANGE OF SETS USING THIS CHASSIS	CIRCUIT TYPE	"INSTANT ON" FEATURE?	NUMBER OF COLOR CONTROLS	TUNING AID?	A.F.C. AVAILABLE?	REMOTE CONTROL AVAILABLE?	PRINTED CIRCUIT OR HAND-WIRED
MIRAL	4H12	$460-$1,300	Tube	Yes	3	None	Yes	Yes	P.C.
IERSON	898A	$450-$1,200	Tube	No	2	None	Yes	Yes	P.C.
	KD	$450-$680	Tube	Yes	2	Meter	No	Yes	P.C.
AGNAVOX	T920	$480-$1,200	Tube	No	3	None	Yes	Yes	P.C.
OTOROLA	TS915 or 919	$630-$875	Tran.	Yes	3	Light	Yes	No	P.C.
ILCO-FORD	18QT85	$550-$1,300	Hybrid	No	2	Eye	No	Yes	P.C.
A	CTC-31	$420-$850	Tube	No	2	None	Yes	Yes	P.C.
LVERTONE (SEARS)	528	$380-$650	Tube	Yes	2	None	Yes	No	P.C.
LVANIA	DO-9	$580-$700	Hybrid	No	2	None	No	No	P.C.
STINGHOUSE	V2655	$460-$900	Tube	Yes	2	Bar	No	No	P.C.
NITH	20YIC48	$480-$1,225	Tube	No	2	None	Yes	Yes	H.W.

black-and-white set: *color* (occasionally labeled *intensity*), which is a color "volume" control; and *tint*, which adjusts hues with the image. A few makes also include a third control that varies the background color.

The point score in this category is an indication of the difficulty—or rather, the ease—of adjusting the controls to produce a viewable color picture. Maximum score: 5 points.

- Color sensitivity. This is a measure of the set's ability to produce a satisfactory color picture from a very weak signal. Each set was tested individually by feeding it a color test-pattern signal and then progressively reducing the signal's strength—with a professional Jerrold attenuator—until the color faded from the screen. A high score reflects high color sensitivity. Maximum score: 10 points.
- Picture stability. Here, we judged a set's ability to maintain a roll-free picture during channel changes, and during scene changes on broadcast shows. Maximum score: 5 points.
- Interference rejection. We utilized three common sources of TV interference to test each set: a workshop hand grinder; a five-watt hand-held CB radio transceiver; and an automobile parked approximately 50 feet away from our antenna, with its hood lifted and its engine turning at 2,500 r.p.m. Maximum score: 5 points.
- Black-and-white picture quality. We judged overall picture clarity, gray scale (black-and-white tonal range), and apparent resolution. Maximum score: 10 points.
- Workmanship. This is a purely subjective evaluation made by our engineer juror of the quality of components and care of assembly that went into each set. The score here assigned a set is *not* a measure of its reliability or expected frequency of repair; we could not gauge these factors during the short time (approximately four weeks) in which we viewed the 11 sets. Maximum score: 10 points.

THE RESULTS Our test results, and the total point score awarded each set, are tallied on the table on the next page.

Color quality. All 11 sets displayed a pleasing color picture, but the Magnavox consistently produced the most lifelike flesh tones plus most natural-looking background colors.

Our jury was surprised at the wide set-to-set color variations. In many ways,

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evaluating color-TV pictures is like comparing 11 types of color film: The images you see aren't necessarily better or worse than each other—they are just different.

Apparent resolution. Here, the Zenith was outstanding. When reproducing a football game, for example, it showed substantial detail clearly in long-distance shots—the heads of players sitting on the sideline and of fans in the stands—that simply didn't stand out from the background on the other sets.

Screen brightness. Again, no contest: The Sylvania produced the brightest picture and displayed the most brilliant whites, although every other set produced a picture more than bright enough for viewing in a normally daylit room.

Ease of color adjustment. All 11 sets required some fiddling to get a perfect color picture—even those equipped with tuning aids or an optional automatic frequency control (A.F.C.) circuit.

Both tuning aids and A.F.C. help you adjust fine tuning. The aids tell you when you've set the knob to the correct position; A.F.C. compensates for small tuning errors, and automatically locks the fine tuning on dead center.

Tonal range. The Motorola displayed a considerably wider tonal range than its nearest rivals—an effect instantly noticeable in close-ups of people: Skin areas were pleasantly modeled, making them seem rounded and lifelike rather than flatly two-dimensional.

Color sensitivity. Every set tested has sufficient color sensitivity to produce a good color picture in any area—metropolitan through fringe—provided it is connected to a suitable antenna system.

Picture stability. The Sylvania stood alone in its ability to ignore momentary signal interruptions that made the 10 other pictures roll and jitter.

Interference rejection. When we tried hard enough, we could ruin all 11 pictures with our home-brew interference generators. However, seven sets were able to reject all *reasonable* nearby interference; the four others were nearly as good but were slightly more vulnerable to the effects of electrical machinery connected to the set's power line.

Black-and-white picture quality. Although most network prime-time shows are broadcast in color, there is enough black-and-white programing on the air to make black-and-white picture quality a big consideration in judging color TV.

Happily, all 11 sets produced adequate, or better, black-and-white pictures when correctly adjusted.

Workmanship. Electronically, the 11 sets can be divided into three categories, depending on type of circuitry:

- Tube type. The majority of the circuit stages in the chassis use vacuum tubes.
- Hybrid. A substantial number of circuit stages are transistorized; the remainder use tube-type circuits.
- Transistorized. The majority of the circuit stages are fully transistorized.

[Continued on page 193]

HOW THE SETS COMPARE: THE PS COLOR-TV TEST SCORECARD

MANUFACTURER	COLOR QUALITY	APPARENT RESOLUTION	SCREEN BRIGHTNESS	EASE OF COLOR ADJUSTMENT	TONAL RANGE	COLOR SENSITIVITY	PICTURE STABILITY	INTERFERENCE REJECTION	BLACK-AND-WHITE PICTURE QUALITY	WORKMANSHIP	TOTAL POINTS
ADMIRAL	16	9	9	4	13	9	4	4	8	8	84
EMERSON	16	9	9	4	12	9	4	5	8	9	85
GE	15	8	8	3	11	8	3	4	8	8	76
MAGNAVOX	20	9	9	4	13	10	4	5	10	10	94
MOTOROLA	18	9	9	3	15	9	4	4	9	10	90
PHILCO-FORD	16	9	9	4	12	10	4	5	8	9	86
RCA	16	9	9	4	12	10	4	5	8	8	85
SILVERTONE (SEARS)	16	9	9	4	12	9	4	5	8	8	84
SYLVANIA	17	9	10	4	13	10	5	5	8	9	90
WESTINGHOUSE	15	8	8	4	12	9	3	4	8	8	79
ZENITH	16	10	9	3	13	10	4	5	8	9	87
Maximum Score	**20**	**10**	**10**	**5**	**15**	**10**	**5**	**5**	**10**	**10**	**100**

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Those engineering masterpieces...

YOUR FEET

By LAWRENCE GALTON

Foot trouble hit the headlines recently—a nasty business called "warm-water-immersion foot" which has put troops in Vietnam out of action as effectively as bullets. In one Mekong Delta operation, more marines came down with it than were killed or wounded.

It starts when calluses expand and contract painfully on water-soaked, wrinkled skin; boot friction aggravates this, and soon the victim can't walk.

Happily, medics have turned up a silicone ointment, the same compound used as a lubricant in high-speed drills, which when smeared on feet and socks is remarkably effective in preventing immersion foot.

Keeping feet in shape is not just a military problem. Except for the common cold and tooth decay, no human ailments are more prevalent than foot troubles. As many as 80 percent of adults have one kind or other in their lifetimes.

And experts say many, if not most, foot troubles are needless, and are mistreated when they do occur. Much of the $2 billion we spend annually on foot powders, sprays, pads, supports,

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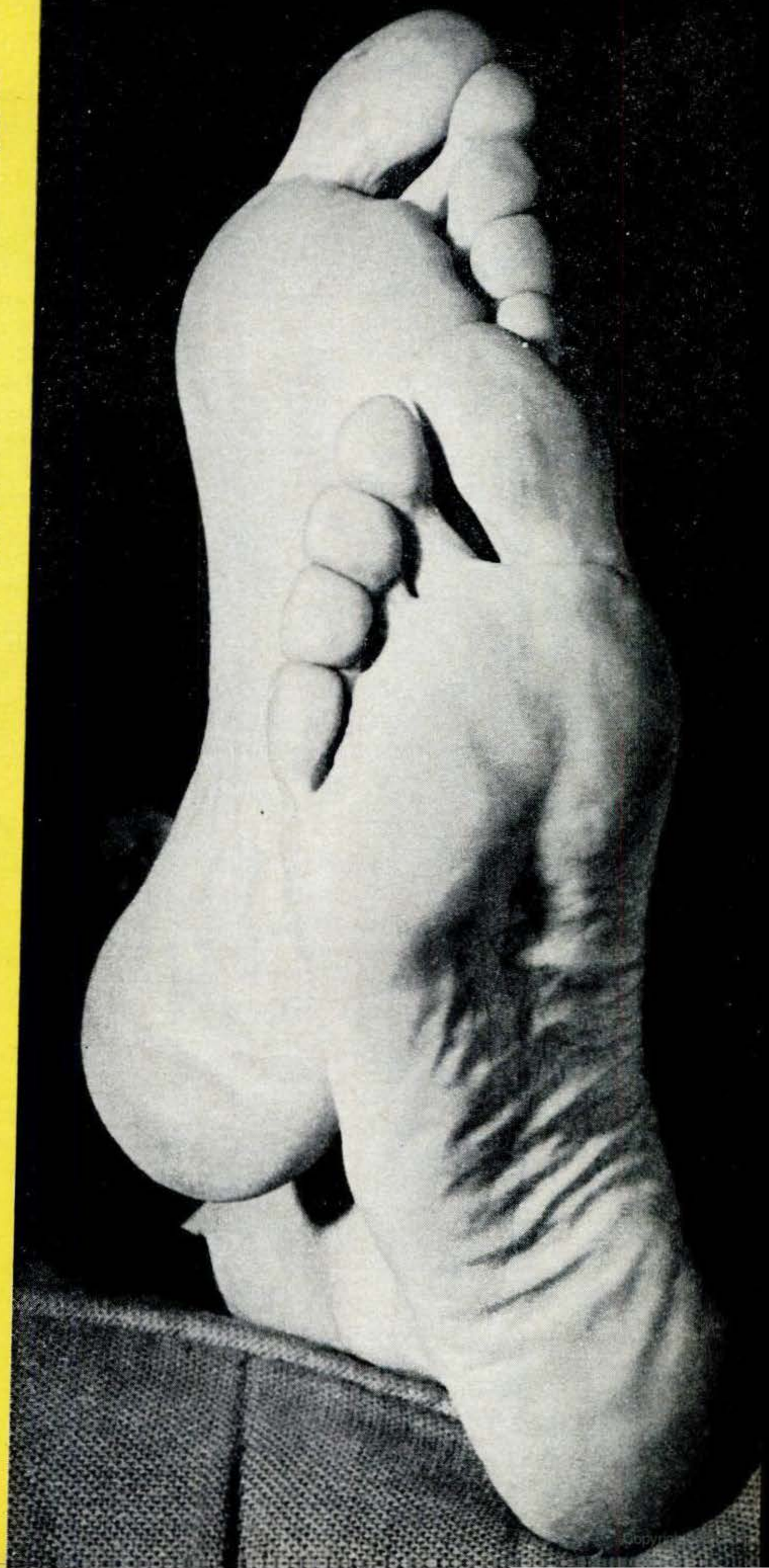
Here are some facts and fallacies about two of your most valuable assets and how to keep them in good shape



Proper-fitting shoes allow your toes to stretch out comfortably (top), but short shoes crimp toes causing irritations. Many foot problems begin here.

and potions to correct foot ailments is wasted because of misinformation and neglect.

Engineering masterpieces. In terms of anatomical engineering, your feet are masterpieces—and they have to be. When you stand, your feet carry the dead weight of the body. Walk—and if you're average, you'll walk some 65,000 miles in your lifetime—and you jolt them with a force of hundreds of tons a day. A 150-pound man walking a mile brings down on his feet a total work load of 132 tons—264,000 pounds.

Your feet have to absorb the impact of body weight and keep the shock from traveling up the network of nerves and joints throughout the body.

In addition, they have to balance the body, propel it, and, working against gravity, get blood flowing back up the legs to the heart.

To accomplish all this, you have 52 bones in your feet—one-fourth of the total number in the body and—they're encased in an intricate system of some 200 ligaments, 40 muscles, and millions of muscle fibers and blood vessels.

Your biggest foot bone is the heel, one of the seven tarsal bones; the other six tarsals arch in front of it—and meet five long bones, the metatarsals, whose heads make up the ball of the foot.

A major part of the body load is borne by bones in the rear; the rest is spread among the long bones in the forepart of the foot. When you walk, body weight comes down on the heel but is quickly transferred to the ball—and from there some goes to the toes which, by their spreading action, prevent turning on the ankles and aid in takeoff for the next step.

When something goes wrong with your feet, the trouble isn't necessarily confined there. Foot discomfort may cause a shift in gait or a change in posture. Other parts of the body, including the spine, may be thrown out of kilter to cause other troubles. Some low back disturbances, joint complaints, even headaches are being blamed on the feet.

Out of whack. About 99 percent of us are born with perfect feet and manage to quickly acquire trouble.

One recent study carried out in seven cities found that 74 percent of children in elementary schools had foot problems; by high school, 88 percent. Here's why. Throughout life the feet are subjected to the stress of standing on hard surfaces. Man doesn't do enough walking, which is good for feet. "Standing," says Dr. Charles Turchin, a Washington, D.C. podiatrist and vice-president of the American Podiatry Assn., "is a great enemy to the feet. It involves 100-percent use;

GI in Vietnam washes his feet beside a stream. Foot troubles there have felled more GIs than bullets.

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oint pains, even headaches

The 26 bones in each foot, shown in drawing at right, form an almost perfect arch, like the kind used in bridge designs.

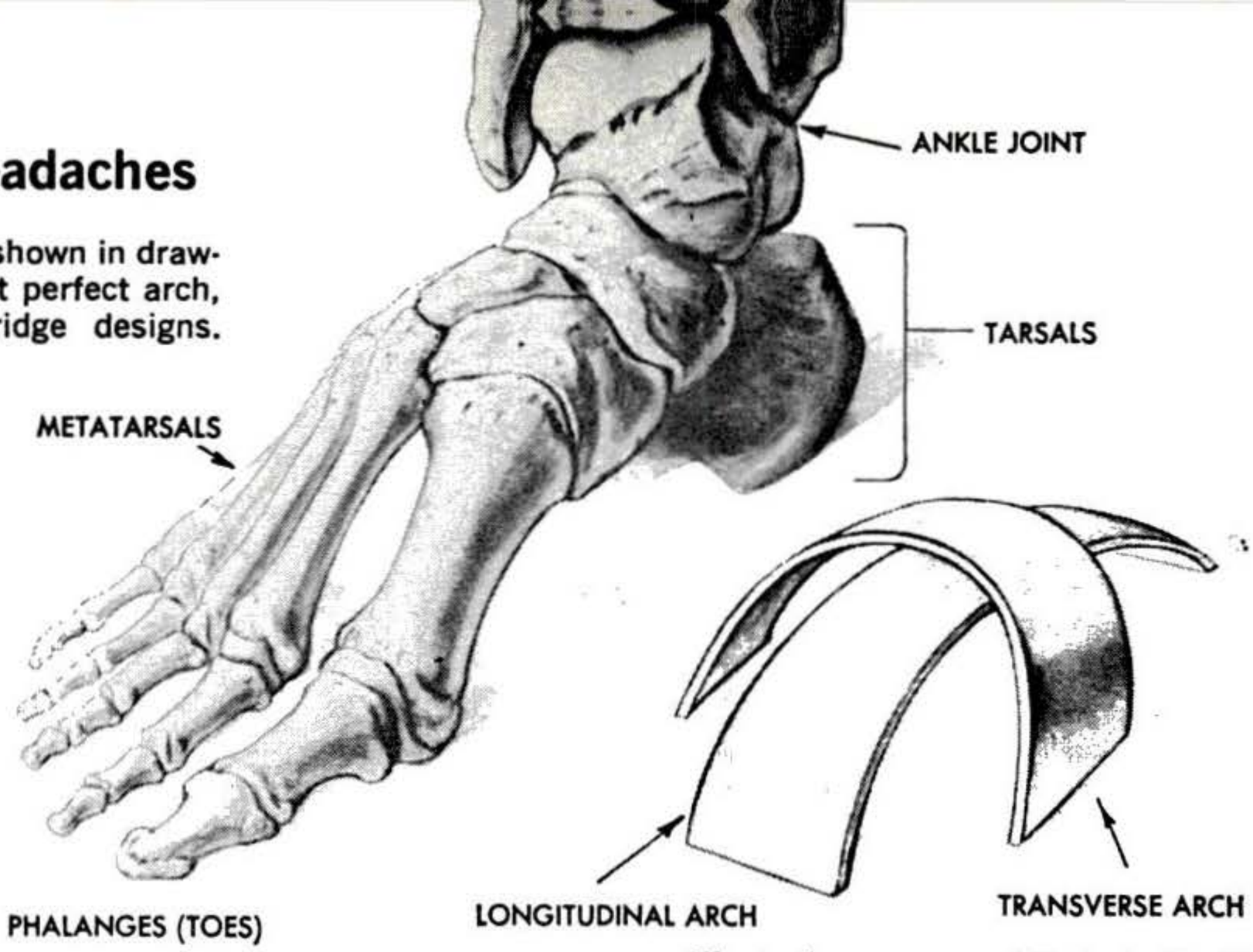

Illustration courtesy of Today's Health, *published by the American Medical Association*

walking, only 50 percent use (in walking, one foot rests while the other supports weight)."

And shoes—poorly fitted and often designed for the eyes, not the feet—also get blamed.

Dr. Henri L. DuVries, a foot specialist who has examined many thousands of feet during the last 30 years, laments "man's insistence on forcing a square into a triangle."

Suggests DuVries: "Slide a shoe off and look straight down at your foot. The sides make roughly parallel straight lines—even the front can be described more or less as a straight line running from big to little toe somewhat like a piece of lumber sawed at a right angle. But look at your shoes—more than likely the toes are shaped like triangles.

"Only when we clothe our feet with shoes do we begin to worry about corns, calluses, ingrown nails, hammer toes, bunions, and other foot ailments," DuVries says.

The myths. We're surrounded by foot myths. They range from the idea that many foot troubles stem from wearing sneakers in childhood (not really harmful) to wearing loafers which are supposed to be bad because they let the feet spread. "Undoubtedly, the foot will grow somewhat larger and wider if not restricted by ill-shaped shoes, but this is healthy," says one authority.

The biggest misconceptions center around flat feet and fallen arches. Because the Army during World War II rejected thousands of men with flat feet, the idea that there's something inevitably wrong with them persists.

Dr. Dudley Morton, one of the nation's outstanding investigators of the foot, says many people with arches "as flat as pancakes" never have experienced foot pain, while some of the most painful and obstinate cases involve feet with well-formed arches.

According to some authorities, only one out of 1,000 persons with flat feet has pain because his feet are flat. The best bet for the flat-footed person, and anyone else with a painful foot problem for which there is no clear-cut, obvious cause, is to get advice and treatment from a physician or podiatrist rather than to keep buying arch supports.

Here are some common foot problems, though, which authorities say can be corrected with simple remedies:

For feet that just ache. All that may be needed is rest and elevation—as much of both as possible—and washing in cold water with an antiseptic soap followed by a sponging with rubbing alcohol.

Excessive sweating. This often can be helped simply with rubbing alcohol and foot powder—applied especially between the toes.

Calluses. On the balls of the feet or tops of the toes, calluses usually come from badly fitted shoes. For lasting relief the shoes must be changed. If the callus is thick, a physician or podiatrist can speed its disappearance by careful paring (something not to be done by yourself).

Heel discomfort. Some physicians recommend nightly soaks in hot water containing Epsom salts and use of a heel pad with a hole at the point of greatest discomfort.

[Continued on page 196]

NORBYE · DUNNE
PS CAR TEST
REPORT

We believe the Norbye/Dunne Report is the best car-testing formula achieved by Popular Science in 20 years. It is far more than a seat-of-the-pants impression. Test conditions are rigidly controlled, and test results are recorded with the most modern instruments: a Tracktest "fifth wheel" (speed), a Tapley meter (deceleration ratio), a Mintex pressometer (pedal pressure). Every car is put through a unique standardized handling test. Finally, the results are impartially analyzed by an outstanding two-man team, and reported to you.

Ernest V. Heyn, Editor-in-Chief

Ford's Mustang (above) comes face to face with its challengers, shown below: Barracuda (top), Javelin (middle), Camaro (bottom). All had standard V-8 engines and four-speed transmissions.

Who makes the best sporty compact? We test:

FORD MUSTANG PLYMOUTH BARRACUDA CHEVROLET CAMARO JAVELIN SST

They're all good cars, but they're all different, too—and each has some flaws that will surprise you

By **JAN P. NORBYE** / *PS Automotive Editor* and **JIM DUNNE** / *PS Detroit Editor*

Ford's Mustang, the first of the sporty compacts, is still the most popular, outselling Camaro roughly two to one.

Plymouth's Barracuda and American Motors' Javelin are fighting for the rest of the low-priced sporty compact-car market. (Lincoln-Mercury's Cougar and Pontiac's Firebird are considered deluxe sports compacts and are therefore not included in this test.) The challengers to the Mustang are not Mustang imitations, for each has an appeal all its own.

Which one would you pick? Drive them all under a variety of conditions and really get to know them. Find out how they react in traffic. Drive them at night, too. Take them to Bridgehampton race circuit for tests of acceleration, braking, and handling. That's the formula we follow. And we'll tell you:

- Which car surprised us most on acceleration.
- What unexpected problems we had with the pedal-operated parking brakes.
- Which cars had the lowest—and highest—noise level.

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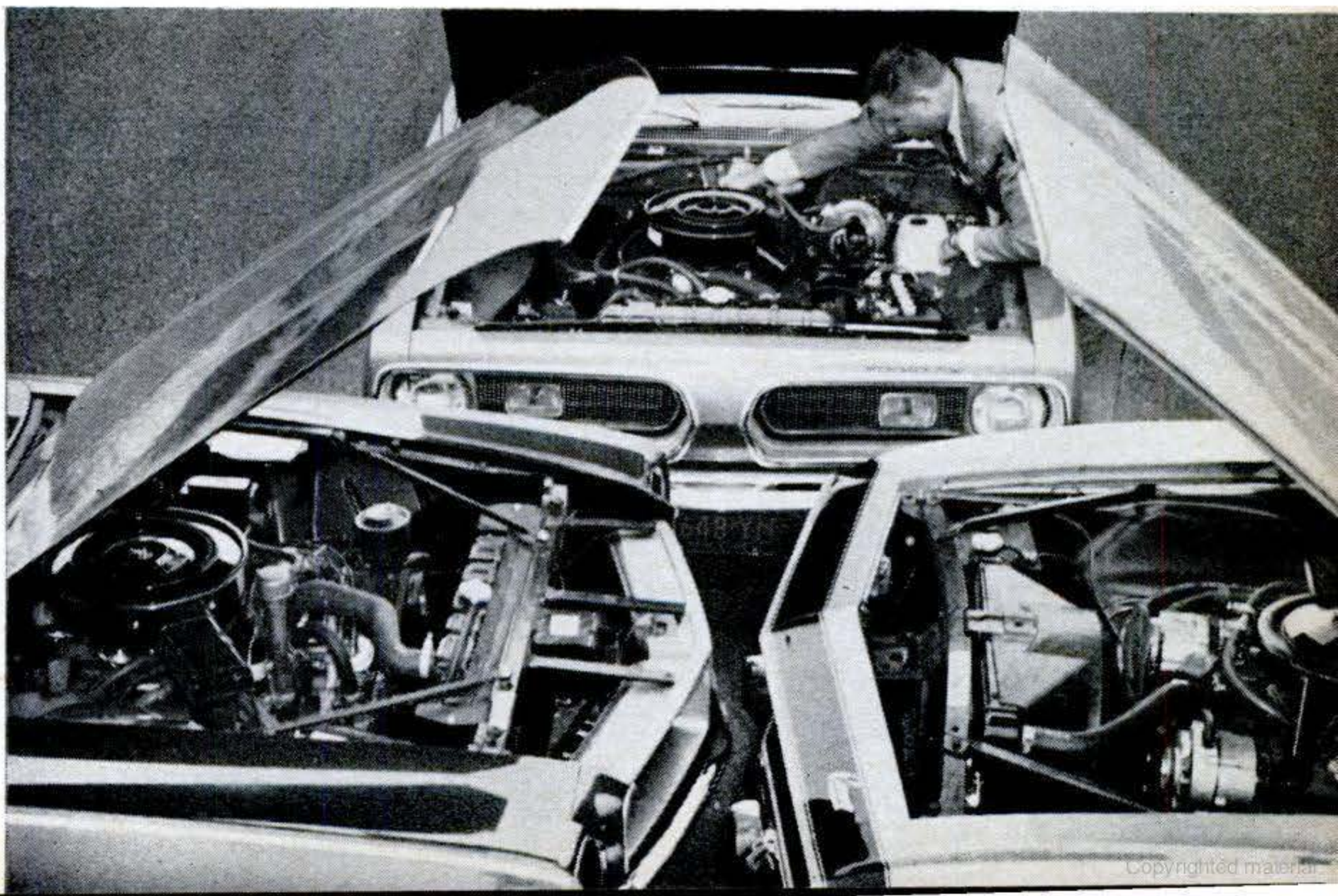

Norbye finds that the Barracuda's wiper motor interferes with removal of the distributor cap. On the Camaro (right), the oil filter was accessible only from below. On the Barracuda, you could get at the oil filter without even dirtying your shirt. The Javelin's oil filter was placed low, down near the generator, but proved accessible from above. Camaro and Javelin have air-injection-reactor exhaust-emission control systems; Barracuda has the simpler CAS, which adds no extra hardware.

PHOTOS BY BILL MORRIS

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Lane change: Mustang's tail breaks away and the driver has to countersteer to stay on course.

Lane change: Camaro shows little lean and felt stable, but was slow in responding to the helm.

- What's wrong with Ford's disk-brake system.
- Why the Javelin used so much gas.

BRAKES This test shows a car's ability to stop quickly, in a straight line, after repeated use of the brakes (as in stop-and-go highway traffic). Ten stops from 60 m.p.h. at one-minute intervals with half-g (16 feet per second per second) deceleration are followed by a final stop for maximum deceleration (minimum braking distance) from 60 m.p.h. in a 12-foot lane without wheel locking.

Results	Distance	Pedal Pressure
Mustang	162 ft., 3 in.	200 lb.
Barracuda	166 ft., 5 in.	120 lb.
Javelin	155 ft., 2 in.	65 lb.
Camaro	187 ft., 3 in.	54 lb.

The Camaro had the most sensitive brakes, and the rear wheels locked under light pedal pressure. To keep from skidding and swerving, the brakes had to be released and reapplied in rapid cycles. This stretched the Camaro's stopping distance. Rear-wheel locking became a problem on all these cars at higher pedal pressures. The Mustang had the same fade problem we experienced with the Galaxie—brake-force bias to the front end was excessive, and the disks overheated, causing pedal pressures to rise beyond acceptable limits.

ACCELERATION The 0-60-m.p.h. test is intended to show a car's ability to reach cruising speed from standstill. The 0-80-m.p.h. test shows its high-speed power reserve. The 25-70-m.p.h. test simulates a highway merging situation or passing on a two-lane road.

Results	0-60	0-80	25-70
Mustang	9.6 sec.	17.0 sec.	10.1 sec.
Barracuda	8.4	15.5	9.7
Javelin	9.2	16.1	10.0
Camaro	10.7	19.2	11.6

The Barracuda felt livelier than the other cars, and we were not surprised that it proved the speediest. But the Javelin's performance seemed incredibly good, in view of its smaller engine, until we found it was equipped with an optional 3.54:1 final-drive ratio. The Camaro was slowest, mainly because of its lower power-to-weight ratio.

LANE CHANGE This test shows a car's ability to make an emergency maneuver at cruising speed. The right lane is blocked at a given point. The left lane is blocked 120 feet beyond. Each car makes the two lane changes in succession, and the test is repeated until safe maximum speed is established.

Results: Mustang, 65 m.p.h.; Barracuda, 67 m.p.h.; Javelin, 66 m.p.h.; Camaro, 66 m.p.h.

The Barracuda set a new record for U.S. production cars with standard suspension. But for body roll (and lifting of one rear wheel) it could have gone faster. The steering worked perfectly at all speeds. This test really shows up the weak points in suspension and steering design. The Mustang broke its tail loose when we attempted a run at 67 m.p.h. The Javelin was just the opposite: Its rear wheels tracked beautifully, but the front wheels began to plow (understeer). The Camaro was well balanced and always under control, but proved slow in its response to the steering wheel. This means that the Camaro demands a driver with quicker reflexes in any situation.

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Maneuvering: Barracuda had no handling or balance problems, but it suffered from pump catch.

MANEUVERING This test shows a car's ability to negotiate narrow, winding roads or heavy city traffic with sharp corners, stopped buses, and double-parked trucks. The car is driven as fast as possible on a snake course through pylons spaced at 48 feet.

Results: Mustang, 30 m.p.h.; Barracuda, 28 m.p.h.; Javelin, 25 m.p.h.; Camaro, 25 m.p.h.

As in the crash-evasion test, the Camaro's speed in traffic weaving is limited by the time lag between the turning of the wheel and the movement of the car in that direction. This car demands more anticipation on the driver's part. The Javelin and the Barracuda were limited by pump catch—the phenomenon that occurs when the power-steering pump fails to keep up with steering-wheel movement. The steering just freezes for a moment. The Mustang had not a trace of trouble at the other cars' maximum speeds, and its limit was eventually set by a combination of wheel spin and understeer. Understeer makes the car go wider and wider as speeds rise.

FUEL ECONOMY

This was somewhat disappointing in all four, but remember we did an awful lot of fast track driving, which forced the average down: Camaro, 12.8 m.p.g.; Mustang, 14 m.p.g.; Barracuda, 13.3 m.p.g.; Javelin, 10.7 m.p.g. The high fuel consumption of the AMC car stands out. Reason: the "short" final-drive ratio.

COMFORT, CONVENIENCE, AND FINISH

You will probably agree that Detroit's sporty compacts are the most exciting group of cars to hit the streets. They have style and glamour, and they are fun to drive. Their design is outstanding: a small transportation package that not only looks different from all other Detroit products, but does not offer passenger space and luggage capacity for the whole family. They have often been labeled "personal" cars, which give them a stamp of exclusivity formerly reserved for the expensive Ford Thunderbird and Buick Riviera. The formula caught on, and now one new car in every eight is a sporty compact. The four cars may be similar in cost and concept, but on closer examination they proved to be radically different in nature and behavior.

BEST FEATURES

Camaro impressed us with its typical GM-ish soft, quiet ride and rich interior styling. Noise levels are surprisingly low for a car in its price class. On a long trip, the superlative interior layout and finish contribute to the physical well-being of the driver as well as the passengers. Of

Continued

Mustang trunk holds only 5.6 cu. ft. of useful space (above). At right, Dunne reaches into the depths of the Barracuda trunk—it holds 15.2 cu. ft. against the Camaro's 8.3 and Javelin's 10.2 (left).

Clutch foot gets hung up under parking brake on the Camaro. The same fault was found on the Javelin.

special interest are the one-piece door-trim panels, which give the car a padded look inside and possibly offer some hip-injury protection.

Other advantages:

- Astro ventilation system gives wide choice of air intakes and improves driving comfort.
- One-piece door windows look "cleaner," cut wind noise, and greatly improve visibility.
- Controls are easy to reach and a cinch to find in the dark (though not automatically lighted).
- Antitheft buzzer reminds you to remove the ignition key when the driver's door is opened.

Mustang interior is well appointed and nicely finished, and the bucket seats are very comfortable. The Mustang ride is firm without being jolty, and the whole car has a pleasant, solid feel. The vinyl door panels are color-matched to the seats, and the nylon carpeting is color-keyed to the interior trim. Other good points:

- Neat instrument panel with large, clear dials and no idiot lights.
- Contoured and padded armrests.
- Pedal-operated windshield washer.
- Ford's two-way (either-edge) keys.
- Telltale turn-indicator lights mounted on the hood.

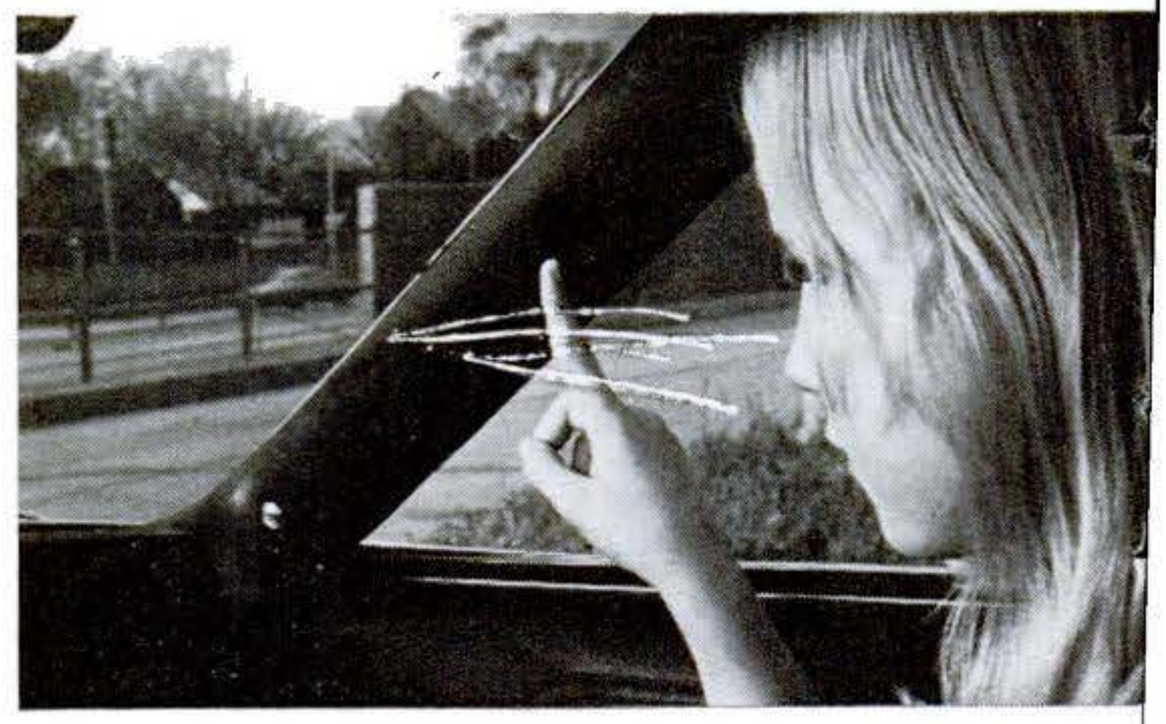
Barracuda's best feature is the splendid performance of the 318-cu.-in. V-8. The lightweight unit construction, in combination with this smooth, high-torque power plant, makes the Barracuda a hot car, just short of the hairy-beast class. Fine features:

- Excellent trunk room—almost standard-car size, and at least 50 percent greater than its competitors.
- Plymouth engine uses CAS (Cleaner Air System) and needs no air pump to reduce exhaust emissions.
- Quick and responsive steering.
- Tough, masculine clutch and transmission units.

Javelin is ahead of the other cars in overall styling. The sharp slope of the windshield posts and the semifastback roof line really set it apart. Surprisingly, with its modest overall dimensions, this is the roomiest of the sporty compacts. Points in favor:

- No vent windows in front doors (improved ventilation and reduced wind noise).
- Rugged bumpers front and rear.
- Reclining seatbacks allow superior seat adjustment.
- Doorbell-type buzzer warns the driver when lights are left on after keys are removed from the ignition. This ingenious little feature ought to save a few batteries!
- Padded A posts and roof rails add to safety.
- Instruments in excellent position, and controls easy to reach (although not automatically lighted).

Console between bucket seats on the Camaro had a slot for keeping the seat-belt buckles handy.



Javelin windshield post is well padded over its entire surface. Note the steep rake of the post.

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WORST FEATURES

Camaro's worst feature is the location of the pedal-operated parking brake. It's okay with an automatic transmission, but with a manual gearbox your left foot is apt to hit the bottom of the parking brake every time you lift your foot from the floor to push in the clutch. Other drawbacks:

- Shift lever placed so far forward that driver has difficulty engaging first and third.
- Neat styling means loss of trunk space.
- Rear seat leg room is tolerable only for very short trips.

Mustang's worst feature is the unusable rear seat in the fastback coupe. One passenger can sit *across* in back, but no padding has been provided to make sideways seating comfortable. Minor beefs:

- Small glove box.
- Trunk space sacrificed for styling.
- Horn ring inconveniently placed (too far below wheel rim for most thumbs).

Javelin's reclining backrest lets Norbye drive with straight arms—like Jimmy Clark at Indianapolis.

Barracuda has two weak points fighting for the "worst-feature" title. First, the interior. It looks and feels more like a stock-car racer than a street machine. Smooth metal trim panels on the doors, a truck-like dashboard, plus a general lack of quality trim throughout the pas-

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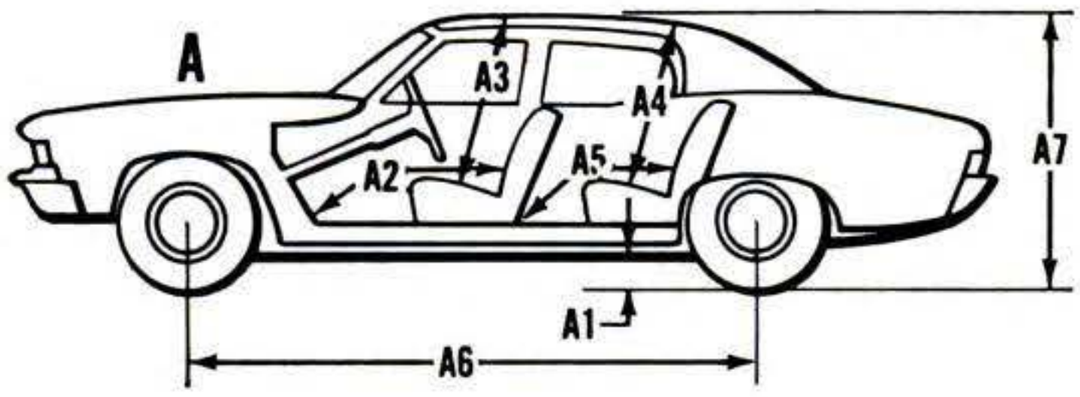

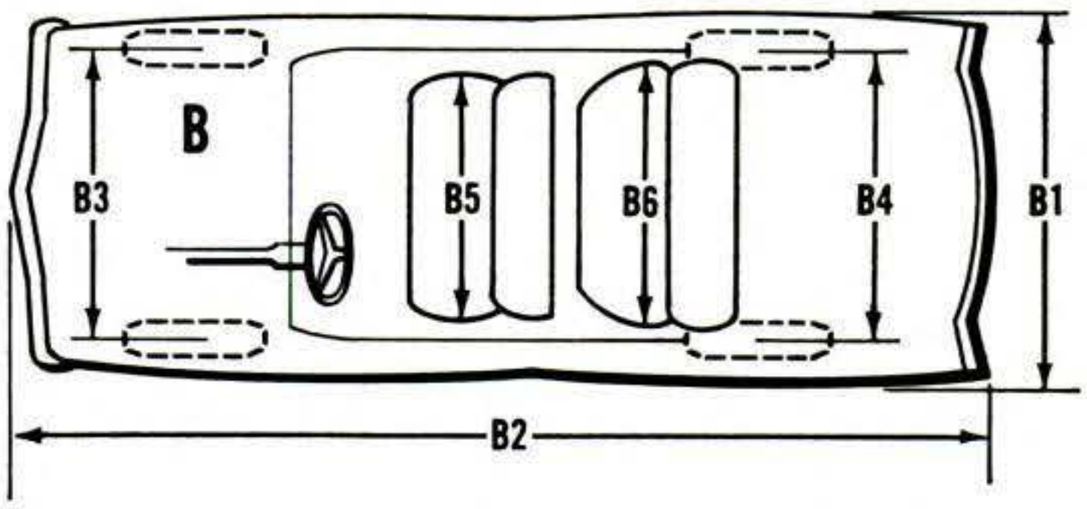

DIMENSIONS (inches)	CHEVROLET Camaro	FORD Mustang	JAVELIN SST	PLYMOUTH Barracuda
A1 Ground clearance	5.5	5.2	7	6.6
A2 Front leg room (max.)	42.5	42	43.3	41.5
A3 Front head room	37	37.1	37.5	37.7
A4 Rear head room	36.7	30.6	36.0	36.5
A5 Rear leg room (min.)	29.2	27	31.5	30.3
A6 Wheelbase	108.1	108	109	108
A7 Overall height	51.5	51.6	52	52.7
B1 Overall width	72.6	70.9	71.9	71.6
B2 Overall length	184.7	183.6	189.2	192.8
B3 Front track	59	58.5	58.4	57.4
B4 Rear track	58.9	58.5	58.4	57.4
B5 Front hip room	56.3	54	57.6	57.1
B6 Rear hip room	54.6	50.8	56.38	57.1
SPECIFICATIONS				
Engine type	OHV V-8	OHV V-8	OHV V-8	OHV V-8
Bore & stroke	4.00 x 3.25 in.	4.00 x 3 in.	3.75 x 3.28 in.	3.91 x 3.31 in.
Displacement	327 cu. in.	302 cu. in.	290 cu. in.	318 cu. in.
Compression ratio	8.75:1	10:1	10:1	9.2:1
Carburetion	Single 2-661	Single 4-661	Single 4-661	Single 2-661
Power @ r.p.m.	210 @ 4,600	230 @ 4,800	225 @ 4,700	230 @ 4,400
Torque @ r.p.m.	320 @ 2,400	310 @ 2,800	300 @ 3,200	340 @ 2,400
Transmission	4-speed, floor	4-speed, floor	4-speed, floor	4-speed, floor
Axle ratio	3.08:1	3.10:1	3.54:1	3.23:1
Tires	Firestone	Firestone	Goodyear	Firestone
Tire size	7.35-14	F70-14	E70-14	D70-14
Steering ratio (overall)	20.6:1	20.32:1	17.1:1	18.79:1
Turns, lock to lock	3.8	3.74	3.6	3.5
Turning diameter	37 ft.	37.16 ft.	36.8 ft.	38 ft.
Brakes	Disk/drum	Disk/drum	Disk/drum	Disk/drum
Brakes, swept area	332.4 sq. in.	324.8 sq. in.	371 sq. in.	314.7 sq. in.
Curb weight	3,156 lb.	3,100 lb.	3,003 lb.	3,025 lb.
Basic price	$2,670	$2,795	$2,564	$2,685
Price as tested	$3,331	$3,519	$3,249	$3,209

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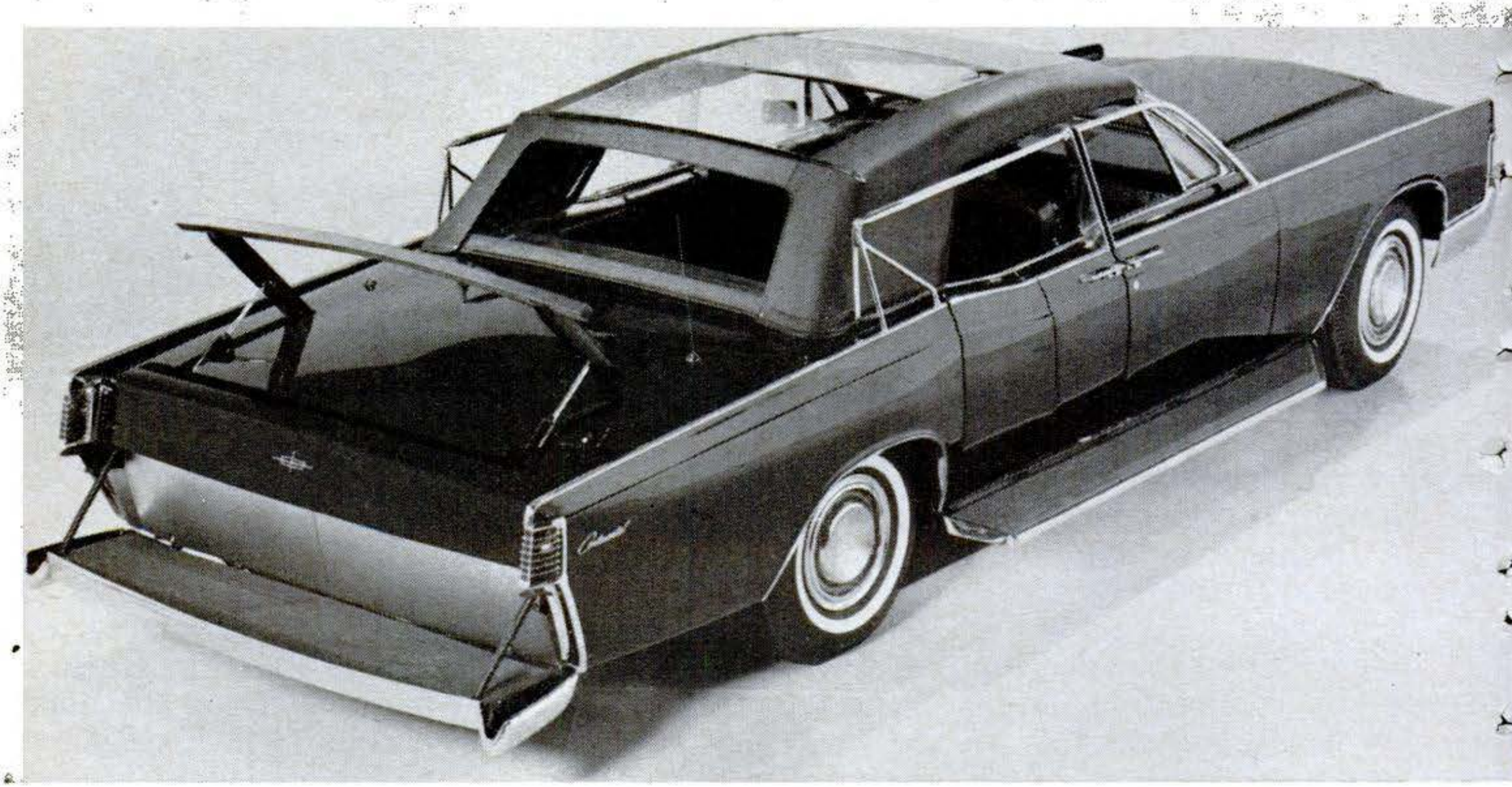
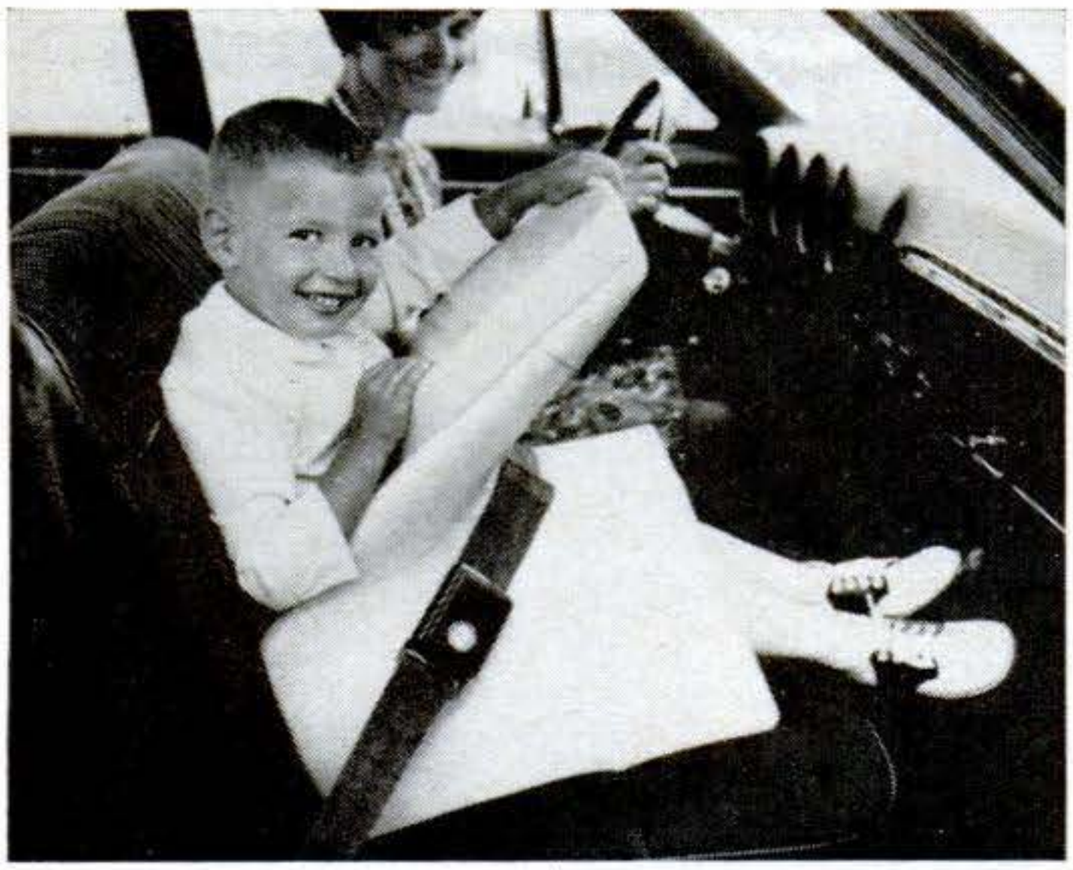


The special Presidential convertibles get an updating

For 10 successive years United States Presidents have used the same two convertible limousines in official functions and parades. Now, at long last, Lyndon Johnson has a brace of spanking-new replacements. Lincoln Continentals, they have 11-inch-wide running boards, plus a retractable rear platform of equal width, for Secret Service men. A hand bar can be recessed flush with the trunk lid. The rear doors of the four-door cars are in two sections to allow agents a 15-inch walk-through. A transparent top permits surveillance of rooftops and other elevated structures.



Tots protected by plastic cocoon

For $19.95 you now can buy an item called a Tot-Guard to protect your moppets from injury in case your car has a collision. Developed by Ford Motor, it consists of a hollow-molded shield and three-inch-high cushion of polyethylene. A removable foam pad fits inside the shield to take impacts. Engineers have crash-tested it for safety.

A new kind of sled for snowy slopes

The belly-whopper may become a thing of the past if a new breed of sled called the Snow-Boat catches on. Or maybe it's a toboggan or sit-down ski. Anyway, it's made of impact-resisting plastic and can be steered. The maker, Snark Products, Fort Lee, N.J., says it can go 60 m.p.h. For protection against bumps, the seat's padded.

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Got acrophobia? Move into this apartment building

Acrophobia is a dread of height. The designers of this 28-story apartment building in Grenoble, France, say the repetitious pattern of the balconies on its face is just dandy for people who suffer from that ailment because it suggests solidarity. Each box balcony is 13 feet tall, 10 wide, and five deep.

The boxes were cast on the site. Their sides are a continuation of the building's reinforced concrete walls. The horizontal portions are cantilevered extensions of the structural floor slabs. The building stands on a circular concrete base 131 feet in diameter and three feet thick, resting on wet soil of an ancient riverbed.

Instant foreign cash

The traveler going abroad from U.S. international airports has only to feed an automatic dispensing machine a $10 bill and push an appropriate button. Out pop bank notes and coins of the country selected. An accompanying pamphlet explains dollar equivalents. You can swap bills for 20 countries.

After 25 years of quiet, unspectacular progress, battery research is taking a great leap forward. A whole host of new types offer capacities 10 times those of the familiar lead-acid and dry cells

New Breed of Batteries Pack More Power

By W. STEVENSON BACON

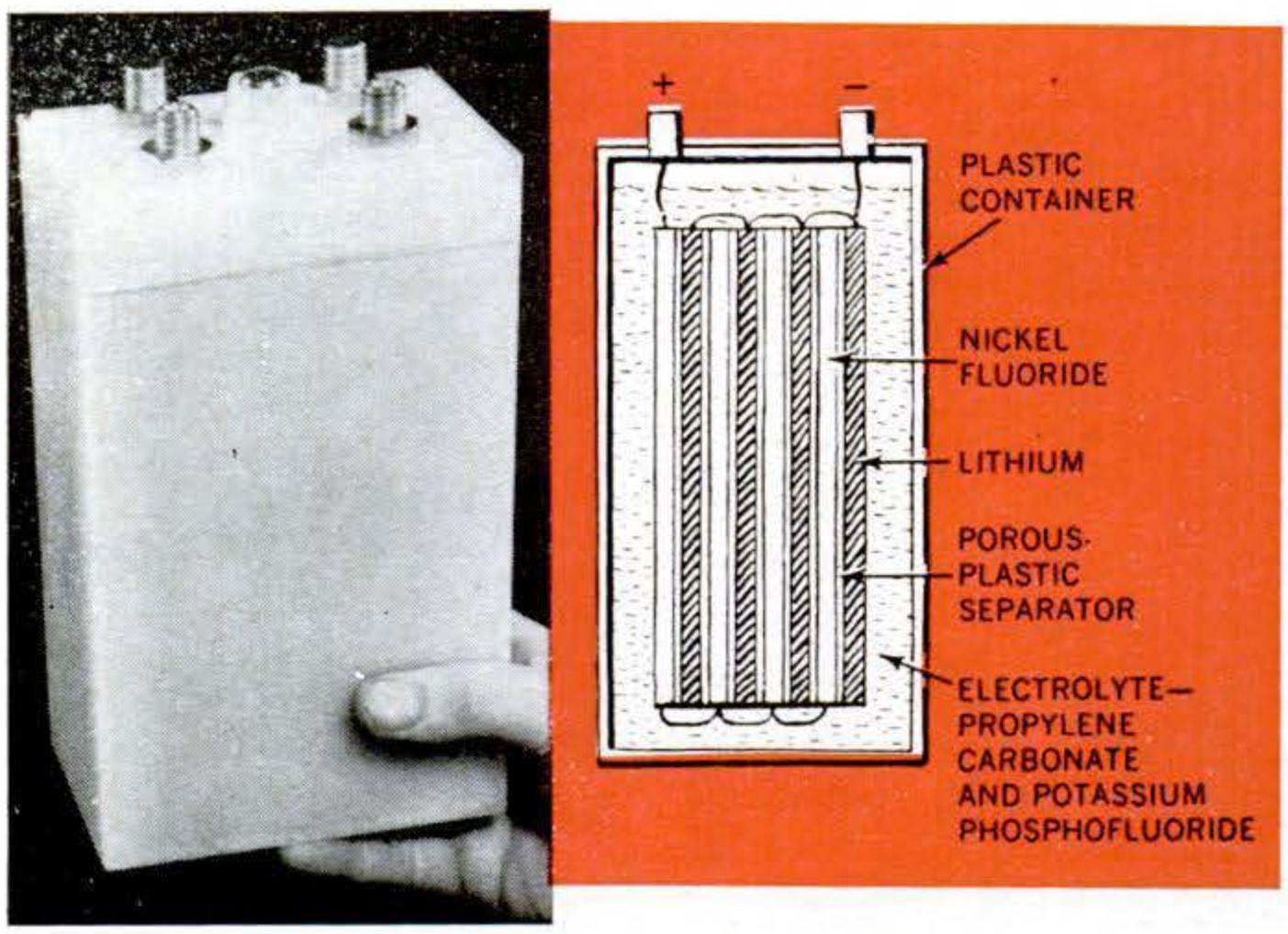
Amitron will have more speed and range than any electric to date. It would take 45 lead-acid batteries (background) to equal its lithium cells in the box at right.

Cascading from laboratories across the country are new batteries that can run your flashlights, radios, and appliances 10 times as long as ordinary cells—and snap back for more. There are batteries you can charge and discharge thousands of times, batteries that make electricity from air. And there is a new pint-size storage battery that will power what may be the first practical electric car.

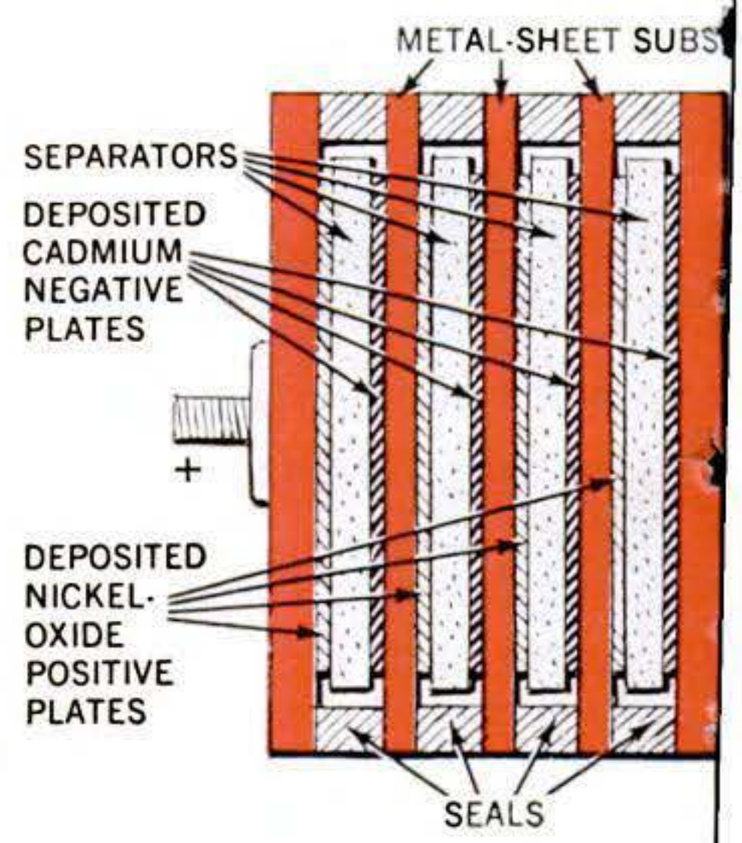
● The attractive little three-passenger electric above, the Amitron just announced by American Motors, uses brand-new lithium-nickel storage cells developed by Gulton Industries. They've got tenfold the capacity of lead-acid cells, but will cost only 50 percent more.

● In a quiet Great Neck, Long Island, N.Y., neighborhood, Leesona Moos Laboratories has come up with something that's bound to cause commotion. It's a zinc-air flashlight cell that's half battery, half fuel cell, and the equal of 10 of its present-day counterparts.

One minor hitch: Flashlights, radios, and tape recorders will have to be de-



Prototype and drawing of lithium-nickel fluoride cell shows how it's made. The cell is sealed, requires no maintenance, produces 100 watt-hours per pound. It will cost only 50 percent more than lead-acid.



Acceleration battery is unique nicad type with positive and negative elements deposited on alternate sides of metal sheets. About two by three feet, an inch thick, 65-cell stack puts out starting current.

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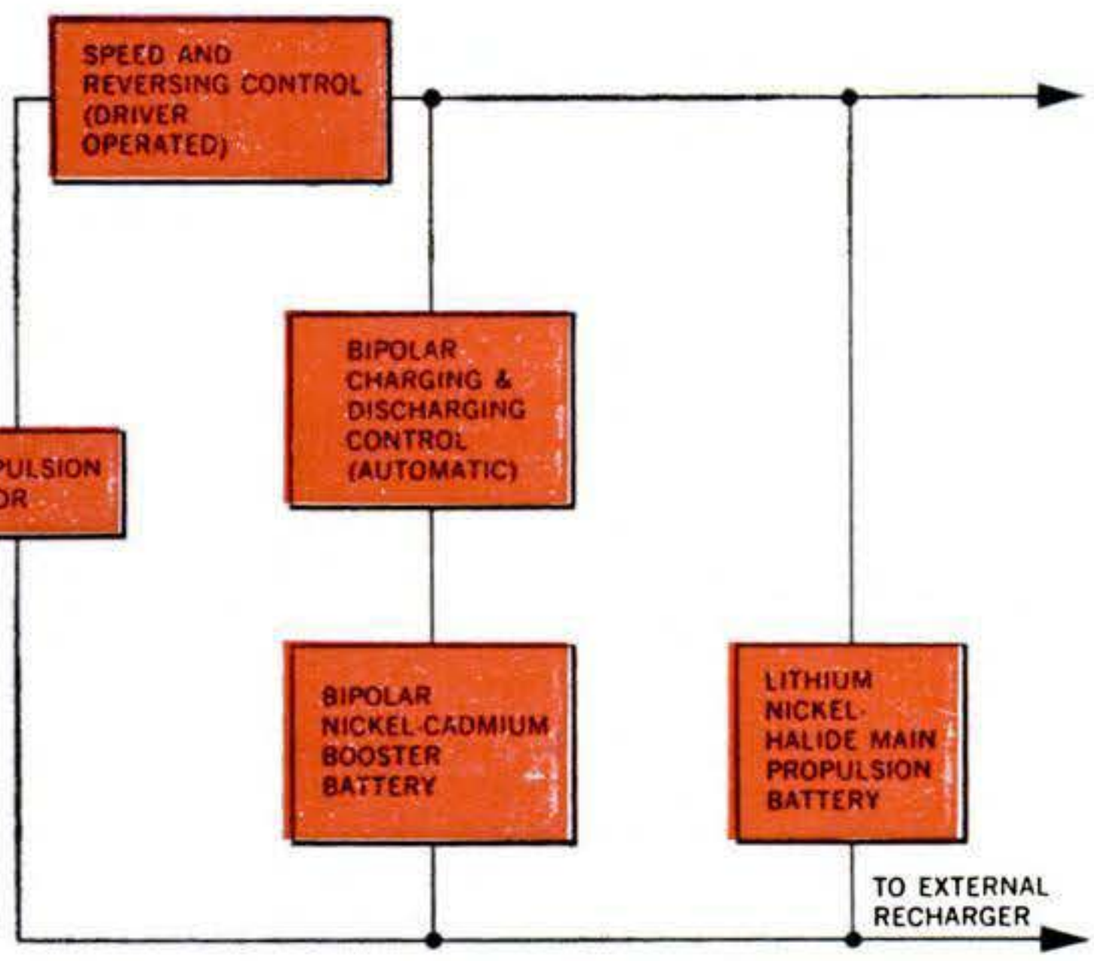
signed with air vents to keep this one running at full power.

• Both Leesona and General Atomic Division of Gulf Oil feel the zinc-air battery with six to eight times the energy density of lead-acid, is also ideally suited for electric cars, and these companies plan to prove it.

• General Telephone has a rugged, rechargeable iron-air battery which is six times as good as lead-acid.

• Similar in principle is General Electric's Magair—magnesium-air battery with five times lead-acid energy densities. Interestingly, it uses common salt water as battery fluid, produces magnesium hydroxide (just milk of magnesia) as a by-product.



Lithium and ni-cad batteries work together to power Amitron. When car is cruising, lithium cells recharge acceleration batteries. Regenerative braking feeds power back to battery system when stopping.

• Argonne National Laboratories has just hit on one of the most spectacular battery schemes. While trying to find ways to convert nuclear reactor heat to power, they came across a combination of lithium and tellurium which, as a storage battery, might give an unbelieveable 2,000 watt-hours per pound, enough power to drive a good-size electric car 200 miles at 60 m.p.h.

Unfortunately, tellurium is now in short supply. Then too, the battery must operate at high temperature (880 degrees F.) like Ford's sodium-sulfur and GM's lithium-chlorine batteries announced a year ago.

• In small batteries, Mallory Battery Co. will next month market some new alkaline cells that will give your flashlights, movie camera, and other gadgets an amazing amount of oomph. The first uprated cell will be a tiny AAA that is equal to the 50-percent-larger AAs. Its secret is new, highly porous electrodes which Mallory will soon begin using in other cell sizes.

• There are plenty of other really fascinating ideas for new batteries and for

Continued

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putting more power into the old types. Some possibilities are tape batteries in which the electrodes are constantly replenished, an improved flashlight battery using magnesium instead of zinc, solid-state batteries, and many more.

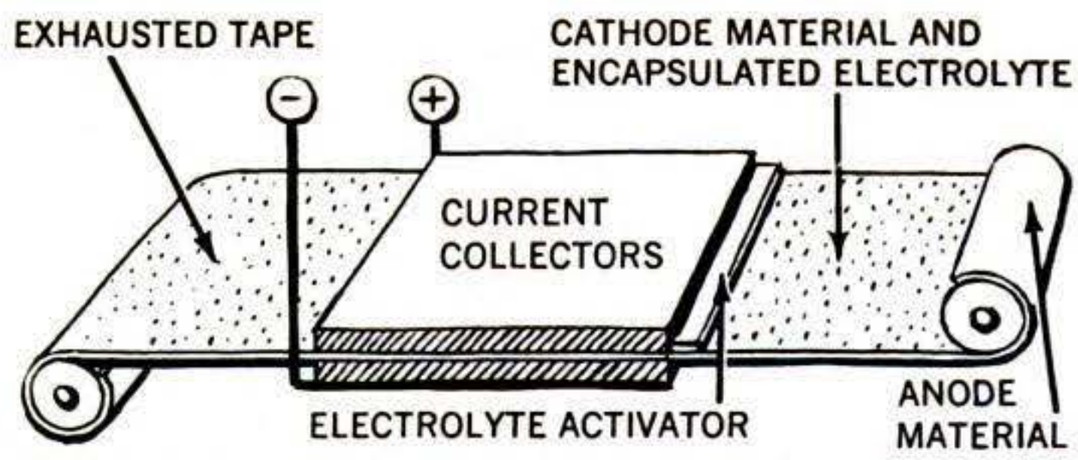
Nature creates a flow of electrons whenever two materials of different electrical potentials are connected together, and the possibilities for new batteries are endless.

Building a battery. Take carbon and zinc, for example. Add an electrolyte—a liquid or paste that lets electricity flow between your two materials—and you've got a battery.

It's a little more complicated to get practical currents, since you also need something to slowly "burn" or oxidize the zinc, freeing more electrons when it is connected to the carbon through a light bulb or other load. Another chemical, a depolarizer, is needed to keep the carbon, which collects positive charges, from becoming coated with waste products as the zinc is oxidized. Then you should have a separator, paper or cardboard, to limit the flow inside the battery between zinc and carbon to positive ions, but that's all there is to it.

Make these chemical reactions reversible so you can feed electrical energy back into the cell, like lead-acid or nickel-cadmium cells, and you've got a storage battery.

If you think *you* could design a battery, you're right. (As a matter of fact, many of the researchers in the field didn't know D cells from doughnuts until the pressure for better military, satellite, and electric-car batteries made itself felt.) But to come up with a light, compact, economical combination of materials to do a specific task takes the talents of both a top-flight researcher and an alchemist.

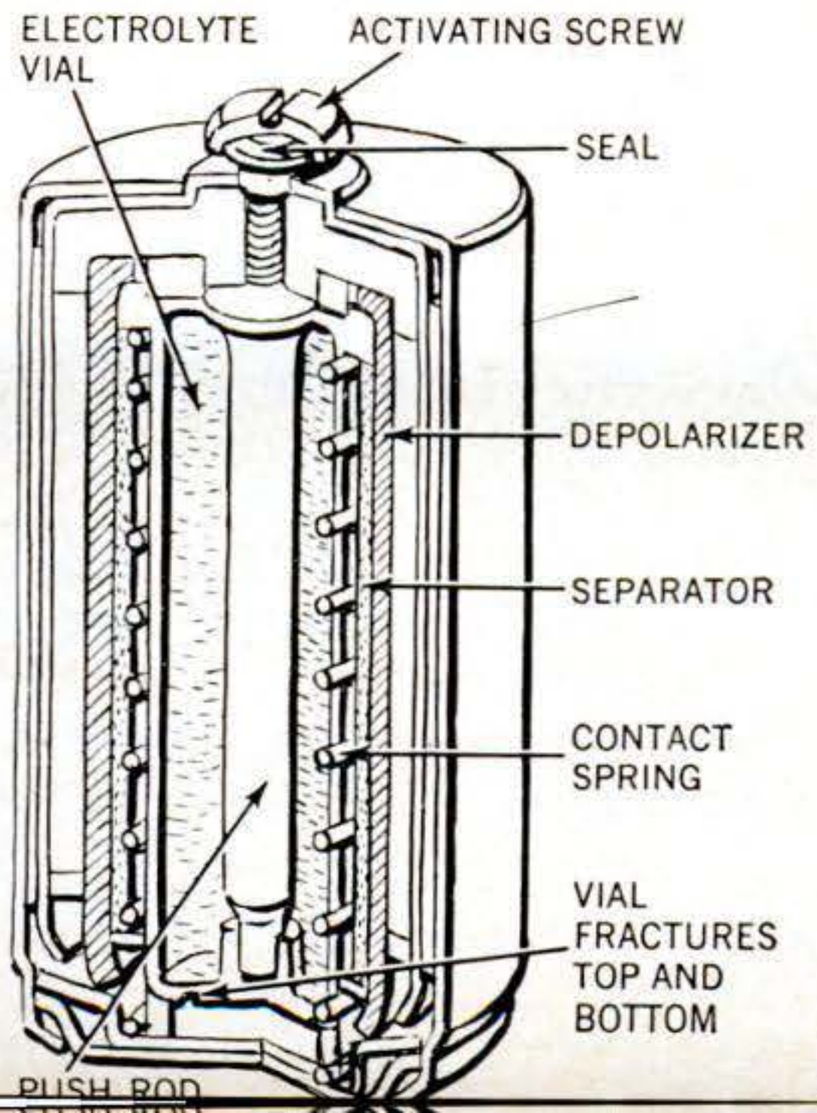


Novel dry cell for powering anything from toys to satellites is tape-fed with anode on one side, cathode on the other, and electrolyte encapsulated in between. As the anode is oxidized, fresh tape is rolled into place. Monsanto is researching the idea.

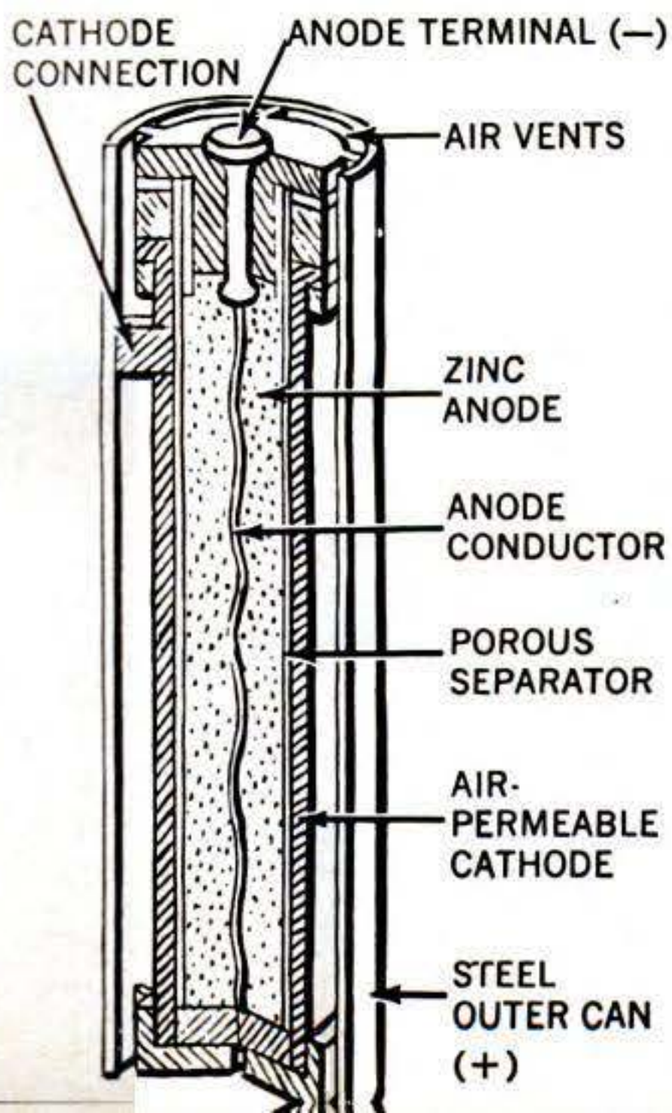
Batteries a black art. Usually, building a battery is largely a matter of cut and try, since, as a Union Carbide engineer told me, "We really don't know exactly what happens inside a battery." Strange as this sounds (Union Carbide is one of the largest battery makers and probably knows as much or more about it than anyone else), it is quite true.

The chemical reactions inside a battery depend largely on the way it's used, the amount of current drawn and how fast it's taken out. Then there are the other variables. How long will the battery be stored before it's used? How much power, for how long, does it have to furnish in what size and weight? Does voltage have

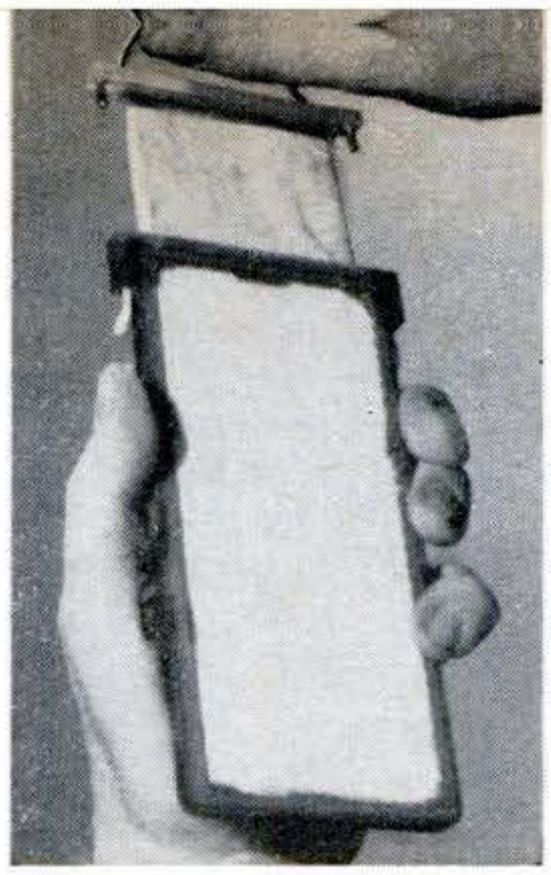
New from Mallory is this reserve alkaline cell which can be stored for years and activated when needed by breaking open vial of electrolyte. The company will also introduce improved conventional cells.

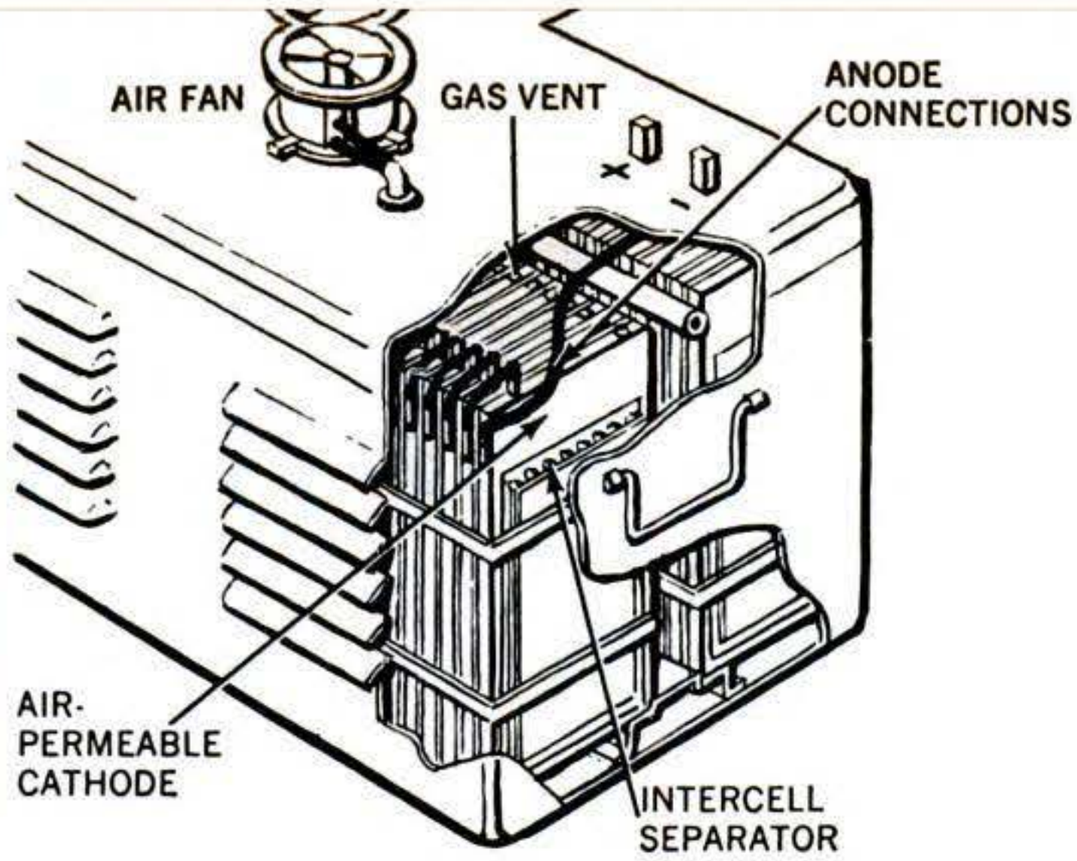


Zinc-air cell for flashlights, radios, tape recorders would outlast 10 ordinary penlight batteries. To keep air circulating down through top of cell-battery-powered devices may have air vents.



High-power zinc-air cells to power Army radios are made by Leesona Moos. Porous zinc anodes (top) are simply replaced when exhausted (lower unit is air-permeable cathode). Drawing shows how cells might be stacked to power a car if they can be made electrically rechargeable. Leesona and others believe they can be.





to stay pretty much the same? Temperature is important since chemical reactions slow down as materials get colder.

If you're talking about storage batteries with their reversible chemical reactions you also have to think about how many times a cell can be discharged and recharged, and how deeply you can discharge it without permanent damage.

The end result of all these imponderables is that battery design is sort of a black art in which the engineers take the best data they can get from the laboratory, add a few pinches of intuition, stir, and serve up the results as a finished —and amazing—package called a battery.

Power for the Amitron. The battery American Motors is counting on to power the Amitron uses lithium and nickel-fluoride electrodes. Many battery designers have been eyeing lithium, for it is both highly reactive (easy to oxidize) and has high electromotive potential. A quick look at a chart found in most chemistry books, the Electromotive Force Series of Elements, explains the last statement. It gives the natural electrical potentials of elements. Lithium, at the top of the list, is virtually dynamite, the most electropositive material known.

One thing that has held matters up is

[Continued on page 206]

Batteries today and tomorrow: a comparison of certain types

Type[1]	Energy Density[2] (watt-hours per pound)	Status	Typical Applications	Comments
Lead-acid (S)	80	Available	Automotive starting	Least expensive for this application
Nickel-cadmium (S)	106	Available	Portable TV sets, tools, appliances	Sealed; permits many charge-discharge cycles
Mercury (P)	116	Available	Hearing aids, transistorized equipment	Maintains constant voltage, long life
Silver-oxide (P)	130	Available	Hearing aids, watches	Maintains voltage, long life
Carbon-zinc (P)	153	Available	Flashlights, radios, toys	Least expensive for intermittent use
Alkaline (P & S)	153	Available	Bicycle lights, movie cameras	For continuous or high-drain applications
Silver-zinc (P & S)	230	Limited	Missiles, aircraft, satellites	Useful where cost is not a factor; long life
Zinc-air (P & S)	600	Limited; under development	All, including electric cars	See text
Sodium-sulfur (S)	650	Under development	Electric cars	Operates at 518° F
Lithium-nickel (S)	750	Lmiited; under development	Electric cars, others	See text
Lithium-chlorine (S)	1,050	Under development	Electric cars	Operates at 1,112° F

1. P stands for primary, S for secondary.
2. Theoretical energy densities are given to indicate the possibilities inherent in the various systems. Actual energy densities depend on a number of factors, and are only 8 to 25% of the figures given.

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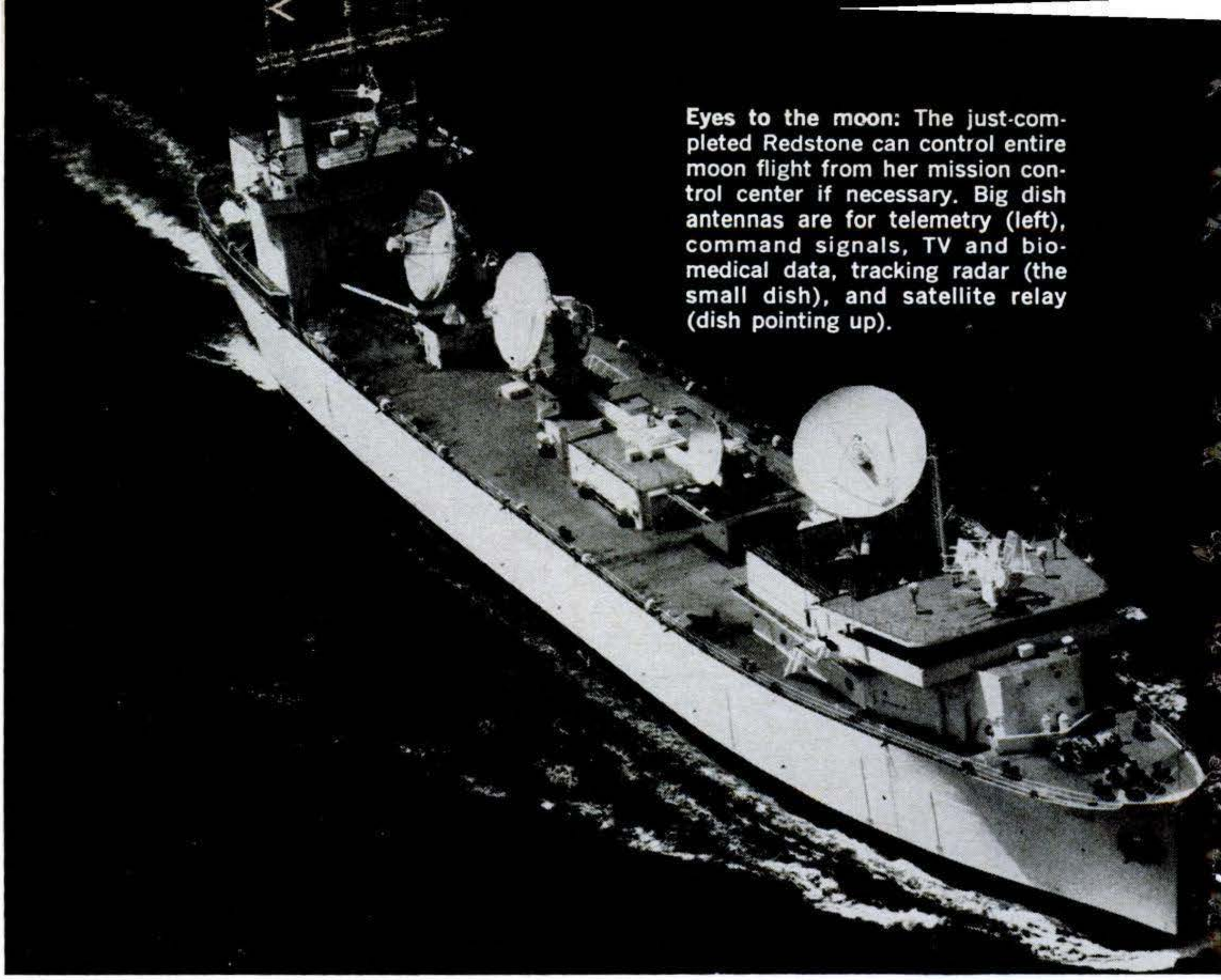

Eyes to the moon: The just-completed Redstone can control entire moon flight from her mission control center if necessary. Big dish antennas are for telemetry (left), command signals, TV and biomedical data, tracking radar (the small dish), and satellite relay (dish pointing up).

Fabulous Floating Control Center

Huge antennas, eyes and ears for our moon shot, mark Redstone—a $45-million engineering miracle

By W. STEVENSON BACON

One fateful day within the next two years, crew members of the USNS Redstone, a smallish converted World War II tanker, will find themselves with a momentous mission. Cruising in the South Pacific off American Samoa, they will be responsible for the safety of our first astronauts to fly to the moon. Second by second, they will check out the condition of the Saturn S-IV B stage that will carry the Apollo out of its parking orbit and into a translunar trajectory.

At control consoles, they'll monitor the astronauts' physical health, reassure them by voice that all is well, feed data to their computers. As the mission progresses, they'll receive and process a stream of telemetry data, voice conversation, and TV pictures from the Command and Service Module (CSM) in orbit around the moon and the Lunar Excursion Module (LEM) on the lunar surface. They may have the critical job of guiding the LEM back from the moon to a rendezvous with the CSM.

Communications terminal. Normally, the Redstone will feed data back and forth via communications satellite between the spacecraft and NASA's Manned Space Flight Control Center at Houston. But if communications become difficult, the Redstone or one of her two sister ships, the Vanguard or the Mercury, may become totally responsible for the success of our first moon mission.

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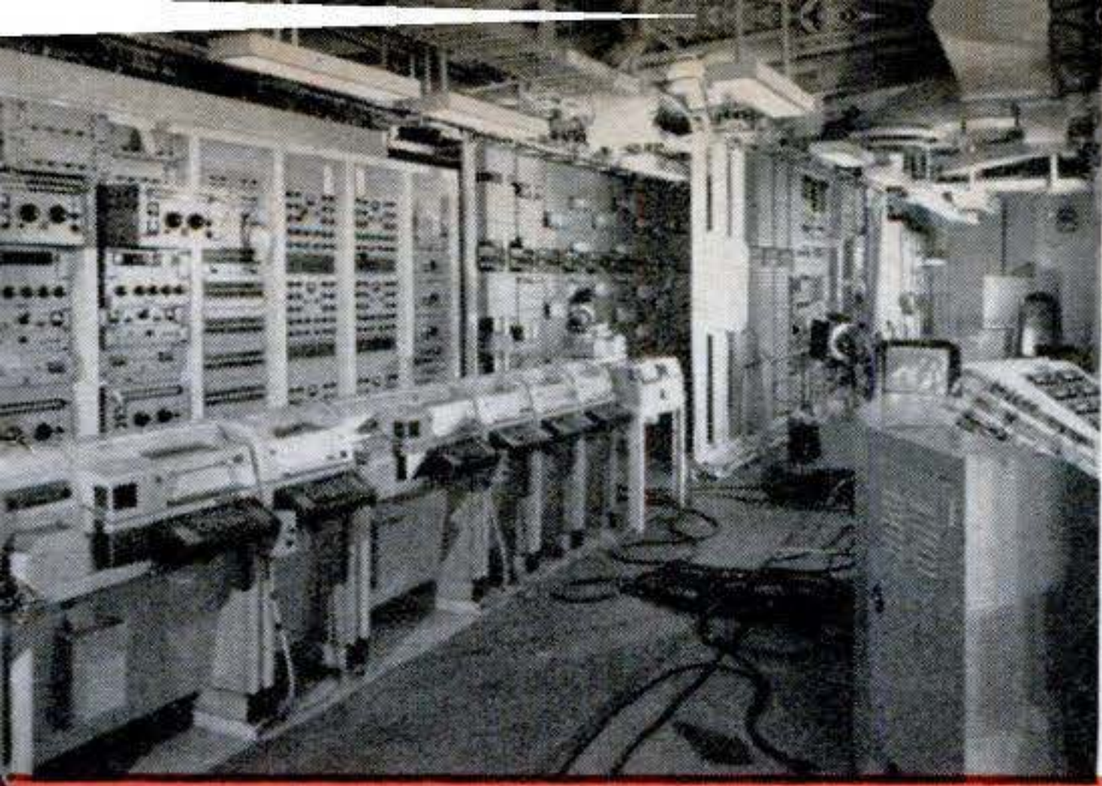
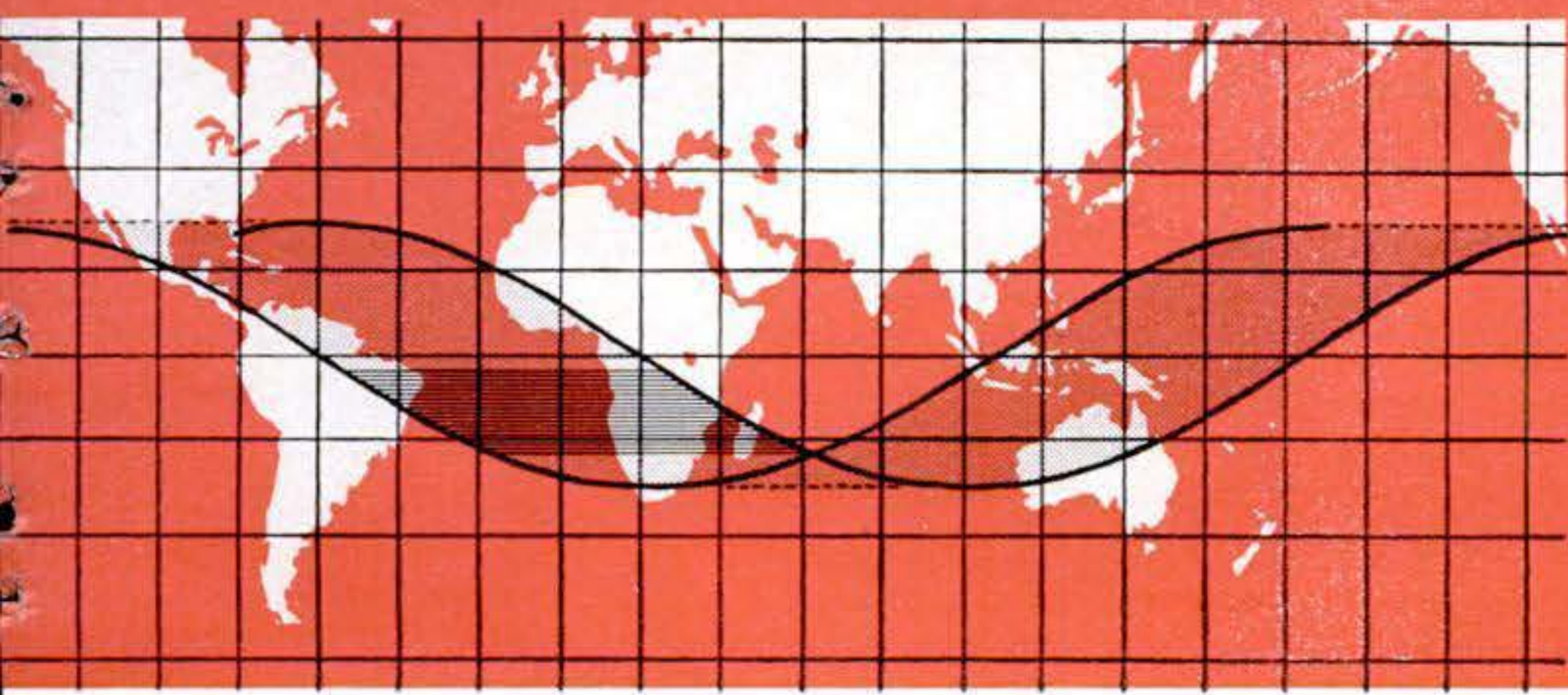
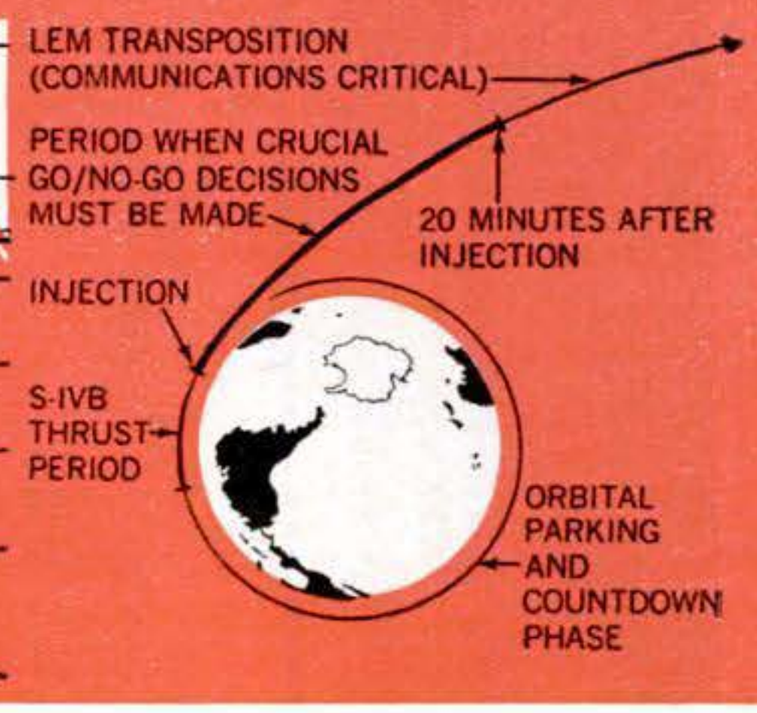


Communications and timing room (above) is typical of equipment-lined decks inside tracking ship. Complex time standards insure split-second timing needed for successful moon flight. Photo at right shows main portion of mission control center—a small-scale duplicate of the main control center at Houston. Drawings below show why the Redstone is needed. During lunar month, Apollo, in parking orbit, could be anywhere inside banded area (left). Shaded area shows where it might be during specific day. Ships cover areas out of range of land stations so critical S-IVB countdown can be made.





Will Guide Us to the Moon

How do you aim an antenna to communicate with a tiny craft 238,000 miles away? It's hard enough to do it on solid ground, but to do it from a ship takes enough equipment and ingenuity to make the Redstone, engineered by NASA, one of the marvels of the space age. It's a little like trying to hit a flying insect a mile away with a rifle while riding on a roller coaster.

The equipment. Crammed below the decks of the Redstone is 455 tons—30 million dollars' worth—of radar, telemetry, command and voice receivers and transmitters, computers, masers, lasers, and the most sophisticated shipboard navigation equipment ever conceived.

Two large 1230 Univac computers will decode and process telemetry data to and from the spacecraft. A third, exclusively for navigation, will receive estimates on the Redstone's attitude, velocity, and position, and compute the most reliable figures of the ship's actual position for tracking spacecraft signals.

Guiding the Apollo and overseeing its mission require that the exact position of the ship be known down to a number of decimal places at all times. Each roll of the ship must be compensated for, or the enormous high-gain dish antennas will lose their signals.

All in all, the Redstone carries three huge 30-foot parabolic dishes for command and control signals to the spacecraft, TV and biomedical data from the spacecraft, and one for receiving and relaying data to and from Houston.

The $15-million Redstone herself was made by "jumboizing" a T-2 tanker at General Dynamics shipyards. A longer and wider midsection brings her length to 595 feet and houses electronic gear, a ship's crew of 88, and 106 technicians.

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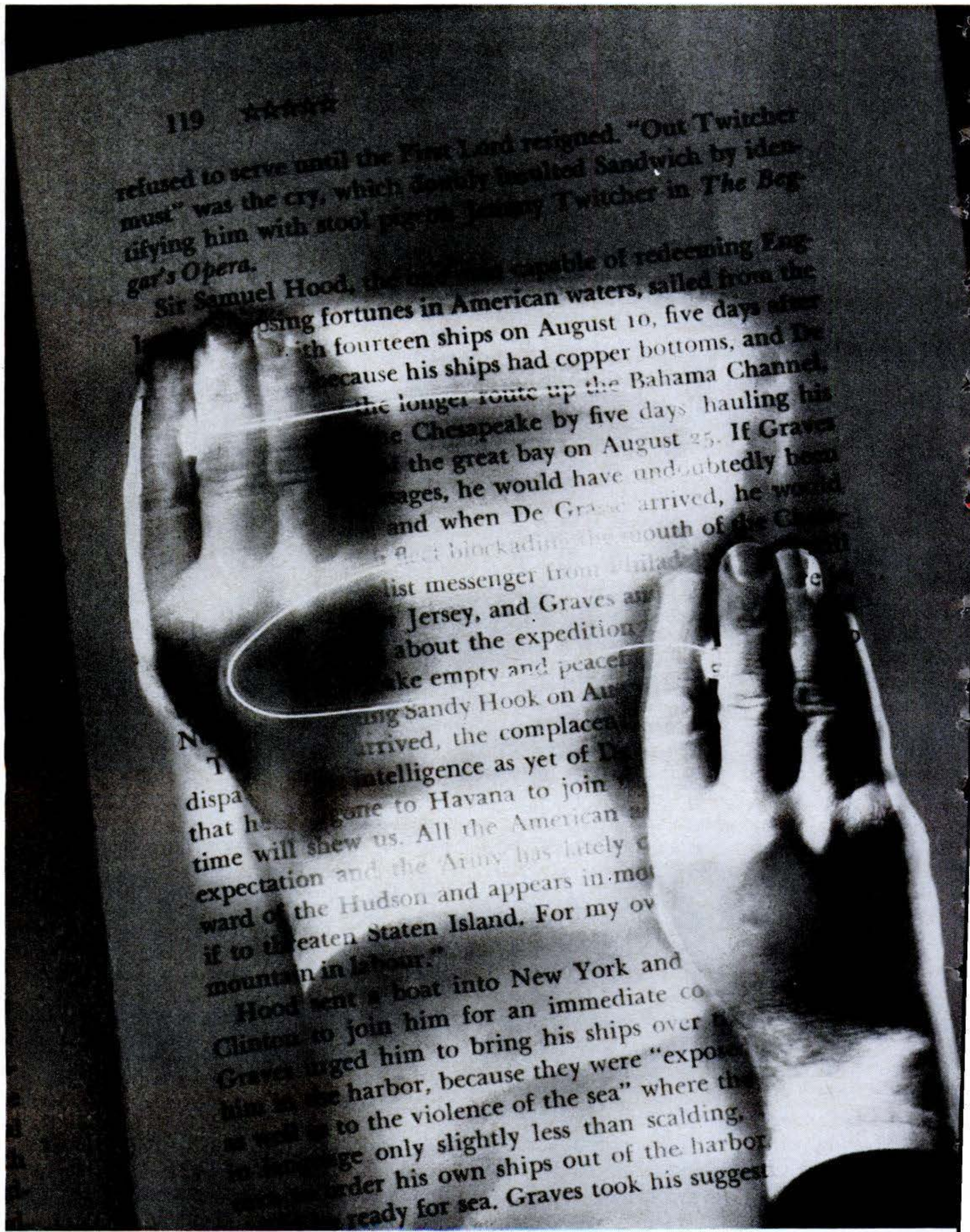
How good are those speed-reading courses?
"Great," says a PS reporter, "but . . ."

So You



Evelyn Wood speed-reading course teaches you to use your hand to pull your mind down the page.

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Want to Read Faster

By ROBERT GANNON

I just read a detective novel. It wasn't very good so I didn't waste much time. It took me 36 minutes. Yesterday I read Hal Clement's *Needle*, an excellent book. I wanted to savor it so I took my time—one hour and 33 minutes' worth.

Two months ago it would have taken me half a day to plow through either of these. In the meantime, though, I've taken a speed-reading course, and now I can gobble up books at what used to seem an astronomical rate.

But is it *reading?* Some authorities claim it isn't. Personally, I don't much care; the technique does what I want it to—sort of.

The thing that prompted me to take the course was the threat of asphyxiation: The piles of unread newspapers, books, and magazines towering about the house might fall on me. But two things held me back:

- Doubts that any system could radically and permanently increase my speed.
- Money: $175 for the course given by the Evelyn Wood Reading Dynamics Institute. (Other schools charge anywhere from $15 or so for classes to more than $200 for individual instruction.)

But I concluded that if I could double my speed—a goal far short of what the ads promise—the $175 investment, stretched out over a lifetime, wouldn't be so much after all. I'd gamble.

Certainly I was in good company. Among the names of the 360,000 Wood graduates appear Senators Stuart Symington (who says he "can now read technical journals about 10 times faster" than before the course) and Herman Talmadge (who wants speed reading introduced to the country's educational system).

Evelyn Wood started it all two decades ago when she was teaching in Utah. "I began to work with the idea of increasing the reading speed of my students," she says. "I knew there must be a faster way of reading." She searched for fast readers, located 50 of them who could top 1,500 words per minute (w.p.m.). "These 50 exceptional readers, I found, had several reading characteristics in common: 1) they all read in a downward direction, rather than from left to right; 2) they absorbed the meaning of whole areas of a page at a time; and 3) they adjusted their speed to the type of material they were reading."

Inhaling reading matter. She quit teaching, developed a program, and began telling adults how to practically inhale reading matter. Today 50,000 students a year take the Wood course.

At the first class I found with a shock that my present workaday reading was abysmally slow: 200 w.p.m. compared with about 300 for the rest of the class. My retention/comprehension rate, though, was high: 85 percent.

Instructor Frank North pointed out some of the bad reading habits we'd have to overcome:

- Many readers "subvocalize"—tend to subtly form words with their vocal cords. Studies at Berkeley's Institute of Human Learning show that an individual who subvocalizes to any great extent "is limited to a top reading speed of approximately 150 w.p.m.—a maximum attainable while reading aloud."
- Slow readers are sloppy readers. Plodding at rates far below their ability, they get bored, daydream, have trouble concentrating, miss whole sections. People who say they read slowly in order to concentrate are fooling themselves.
- When a person reads, his eyes don't sweep smoothly across the page, but stop every so often when the actual seeing is done. Slow readers pause a lot, fast readers rarely.
- Most readers not only stop but go back. The sentence: "A rider came racing down the road out of control," may seem to read, "A driver came racing down the road racing down the road out of control." Poor readers may retrogress

Continued

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from eight to 11 times per 100 words, good readers not at all.

• Most readers fight changing their habits because relearning is hard work, and they somehow feel that a suggestion for change is an attack.

Reading schools try to eliminate bad habits by forcing a student to go so fast he hasn't time for nonsense. Most do this by using machines. Some use a tachistoscope to flash words or phrases rapidly on a screen so students learn to see quickly. (This is something like the device used in aircraft-spotter classes during World War II.) Other schools use pacers, desk-top gadgets that slide curtains down pages of text slightly faster than the reader's "comfortable" speed.

The Evelyn Wood school uses a finger. Yours. "We train you to use your hand to pull your mind down the page," says North. "Soon you find your mind controlling your hand."

Out go the bad habits. Sounds simple. And it is, really. But that first lesson was the start of eight weeks of mental misery —a 2½-hour session a week plus an hour-a-day drill—in which my old comfortable way of reading would be strained, uprooted, and twisted out of shape.

The first week consisted mainly of learning how to use the finger as a pacer. The primary object is to "underline" a line or block of lines by sweeping the hand across the page at one-second intervals. The action pulls your eyes along, preventing flip-backs. (Eventually you learn to slant the sweep so the pattern resembles that of a flat Z then an S stretched vertically—and then, with some students, a line straight down the page.)

Each week we would be given individual, minimum reading speeds we must adhere to in our homework drill, said North. The first week we'd all have the same minimum: 800 w.p.m. (That's two of these PS lines a second.) "But you don't have to stay at that low rate."

At home we practiced first with our books upside down, simply to get the rhythm of hand sweeps. Then, using what the school calls a "lazy-S" hand motion, we ran through 10 pages at two sweeps (two seconds) per page, then at three sweeps per page, finally dropped down to the sluggish 800 w.p.m.—or about 25 sweeps (depending on the book). At two sweeps, if we understood what we were "reading," we would be going at something like 10,000 w.p.m. But at that speed the only story line I picked up was that a couple of guys did something. And that, it seems, is as much as we were expected to get out of it.

Faster and faster. A week later, everyone was disgruntled. North's response was to urge, egg, and insult us to go faster and faster. The important thing was not comprehension, North said, but to get the *feeling* of going fast.

The prime assignment for the second week's homework was to concentrate on the Z form of finger-tracing—extremely difficult because when you're on the downward stroke you're forced to sort of read backwards. "It's your introduction to the art of out-of-order reading," North said. "And I've never seen anyone come out of this week with a heck of a lot." He was right. I didn't.

But on my homework paper I noticed that my reading minimum had climbed to 1,000 w.p.m.

One object of speed-reading courses is to get you used to seeing chunks of reading matter. So during our third week's class session we used booklets with word groupings. We'd flip by these as quickly

Teach Yourself Speed Reading

If you want to make the effort, you can improve your reading speed dramatically. To step up your rate, try the following:

1. Consciously push yourself to go faster, even with the attendant faults. You'll improve your speed if you keep the pressure on until the higher rate becomes habitual.

2. You may be subvocalizing. Stop it. Hold a pencil in your mouth, between your teeth while you read, without letting your lips or tongue touch it. Keep practicing with the pencil in your mouth until any trouble you have disappears.

3. Draw a line down the center of a newspaper column. Looking at only the line, try to read the column, using your periphera

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the speed techniques

How to read straight down a page, rather than across, is demonstrated to speed-reading students. You begin by developing a flat Z pattern, then an S stretched vertically, and ultimately a line straight down the page.

as possible, trying to pick them up on the way. On one page, for instance, was this:

WHEN IS
YOUR BIRTHDAY?

On other pages were other groupings:

WHAT SHOULD WE
DO ABOUT THE
CITIES?

I WENT TO
THE STORE.

I WENT TO THE
STORE TODAY
AND BOUGHT.

I WENT TO THE
STORE TODAY AND
BOUGHT A BOX
OF STARCH.

We were then given a test in what the institute called an impossibly tough book: Willy Ley's *Satellites, Rockets and Outer Space.* The test was on a chapter on Mars, read at above 1,000 w.p.m. My comprehension score: an amazing 90 percent. My nearest competitor got something like 40 percent. (But I had just researched an article on Mars.)

The third week of homework upped my rate to 2,000 w.p.m. Ridiculous. But I *was* moving my hand rhythmically.

By the fourth lesson, though, I was really discouraged. I was learning to skim, but not very effectively. North had me reading at 2,500 w.p.m., but I retained virtually nothing. I found myself simply watching my finger go down the page and thinking about other things.

And the practice time was hard to fit in. During this fourth week I lost so much time I had to join another class, one that had begun a week after mine.

My new teacher was Jeff Weisenfeld, who spoke fast and frequently, like a lawyer—which he is during the day.

Students in *his* class were complaining, too. No retention, they said. "You're wrong," answered Weisenfeld. "Have you ever tried to think of nothing? You can't do it. Now, as your hand travels down the page your mind picks up some of what your eyes are seeing. You're gathering in a good amount, but you don't realize it."

During that session we exercised through our first whole book. John Steinbeck will be unhappy to learn that I zipped through his 29,500-word novel, *The Pearl,* at the rate of 2,110 w.p.m. Took me 14 minutes. But please don't ask questions.

Now I was pretty well convinced the whole course was one gigantic put-on. But then I had to cull data from a volume of 250,000 words. At my old rate of 200

[Continued on page 212]

vision to see the far edges. Practice every day until you can read a column well; then try books and magazines. The practice will help you see larger blocks of print.

4. Use your hand as a pacer, as described in text. Move your finger under one line at a time, then under two or three lines; then use your whole hand to "pull" your eyes down the page.

5. To guard against your eyes flicking back up the page, hide what you've read with a piece of paper, sliding it down the page as you progress, forcing yourself at each session to go faster, faster.

6. Chart your speed rates. Fill in the chart every day to keep yourself thinking speed, to push yourself onward.

Your progress rate will surprise you.

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Our 1968 Test Record

Classic guitar, being played by Tony Mattola, provides a stiff test of your system's high-frequency response.

String bass tones will show up your stereo set's low-frequency response, and phono cartridge's groove-tracking ability.

Bongo drums, play Bobby Rosengarten, an excellent test ment to measure sy transient response.

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Checks Out Your Complete Stereo Rig

It contains a combination of musical passages and electronic tones that "road-test" your hi-fi system

By **RONALD M. BENREY** / *PS Electronics Editor*

Here's the next best thing to an audio laboratory in your basement—a brand-new stereo test record that helps you gauge the performance of your stereo high-fidelity system. You'll use it when you set up the system, to check speaker phasing and channel balance. You'll use it periodically to check sound quality, so you can spot any deterioration of component performance. You'll use it as a demonstration record, to show off your system's capabilities. And you'll use it as an audio standard when you go shopping for new equipment—it makes a perfect listening yardstick for comparing competitive audio gear. *Continued*

o insure accuracy, the record was made under careılly controlled conditions. Many of the musical pasıges were recorded and mastered at the A&R tudios in New York City. The recording engineer : the master control console above is Phil Ramone.

Enoch Light, shown at the controls of an eight-track Scully recorder, closely supervised the production of Side 2, the musically oriented portion of the record. Much of the material on it was composed and arranged especially for the PS test record.

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Your two ears are the only "test instruments" you need

POPULAR SCIENCE helped design this new test record in cooperation with The Total Sound, Inc.—producers of the "Project 3" stereo recordings ["Today's Stereo Sound," PS, Aug. '67].

The two sides of this record are distinctly different:

- Side 1 contains a carefully selected assortment of electronic test-tone patterns recorded under precisely controlled laboratory conditions; we'll discuss their uses shortly.
- Side 2 is a musical anthology that includes several demonstration passages played by different solo instruments, and a group of selections played by complete orchestras. These were chosen by Enoch Light, musical director of Project 3, for their ability to tax your stereo system's capabilities to their maximum limits.

The nine test-tone bands make it easy to set up your stereo system properly, and then periodically check out the performance of its components:

1. Channel identification—two 1,000-Hz tones, one recorded on the left followed by one recorded on the right. It verifies that all components are interconnected so that right and left channel information on the record's groove are reproduced by the proper speaker.

2. Speaker-phasing test—a steady 100-Hz tone recorded on both channels. It verifies that both your left and right speakers are connected to deliver in-phase sound. Out-of-phase speakers produce a hollow, washed-out sound, since the out-of-phase sound waves they produce partially cancel each other in the open space between them.

3. Speaker-balance test—a steady 1,000-Hz tone recorded on both channels with equal amplitude. If the balance control on your amplifier is set properly, the tone should seem to come from between your speakers when you sit at an equal distance from each.

4. Frequency-response test—a series of steady tones ranging from 30 Hz to 10,000 Hz. If your stereo system—including phono cartridge, amplifier, and speaker systems—has an overall flat frequency response, every tone in the series will sound equally loud.

If not, you can touch up your amplifier's bass and treble controls to produce a uniform response.

5. High-frequency-tracking test—four short passages containing bell-like sounds, recorded at successively higher levels. This band tests the ability of the stylus in your phono cartridge to follow an exceptionally rapidly undulating groove. If the stylus is tracking poorly you will hear a buzzing sound along with distorted bell tones, especially when listening to the louder passages.

6. Glide tone—a continuous tone that starts at a frequency of 15,000 Hz, and smoothly drops to 30 Hz. As it descends, you'll be able to detect unpleasant resonances—sympathetic vibration—of the tone arm, speaker system, and furniture within your listening room, that cause buzzes, rattles, or lack of smoothness.

7. Low-frequency-tracking test—four brief passages containing bass-drum sounds, recorded at successively higher levels. It tests your cartridge stylus' ability to follow the very wide groove excursions produced by low-frequency tones. If the stylus is tracking poorly, you will hear a rattling sound superimposed atop distorted drum tones.

8. Quiet groove—a recording of several seconds of complete silence. This is an excellent means of gauging how much rumble your record player produces, and how much motor noise your cartridge picks up. Depending upon your record-player's quality, what you will hear will

Here's how to get your copy of this exciting 1968 PS test record

When the Project 3 POPULAR SCIENCE Stereo Test Record goes on sale in record shops later this year, its suggested retail price will be $5.79—a price that reflects the care with which it is made, and the quality of the materials used.

You can order it now, by mail, for the special introductory price of $2.98 (postpaid).

Send a check or money order (please do not mail cash) for $2.98 to: Stereo Test Record, Project 3, 1270 Avenue of the Americas, NYC 10020.

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to use the PS test record

range from nothing, to a good imitation of a train going through a tunnel.

9. Standard A tone—a precise 440-Hz tone. You can use it to tune musical instruments, as a signal source for trouble-shooting your audio equipment, and to check your record player's speed accuracy (by comparing the tone you hear with a tuning fork, or with the standard A tone broadcast by the U.S. Bureau of Standards short-wave station, WWV).

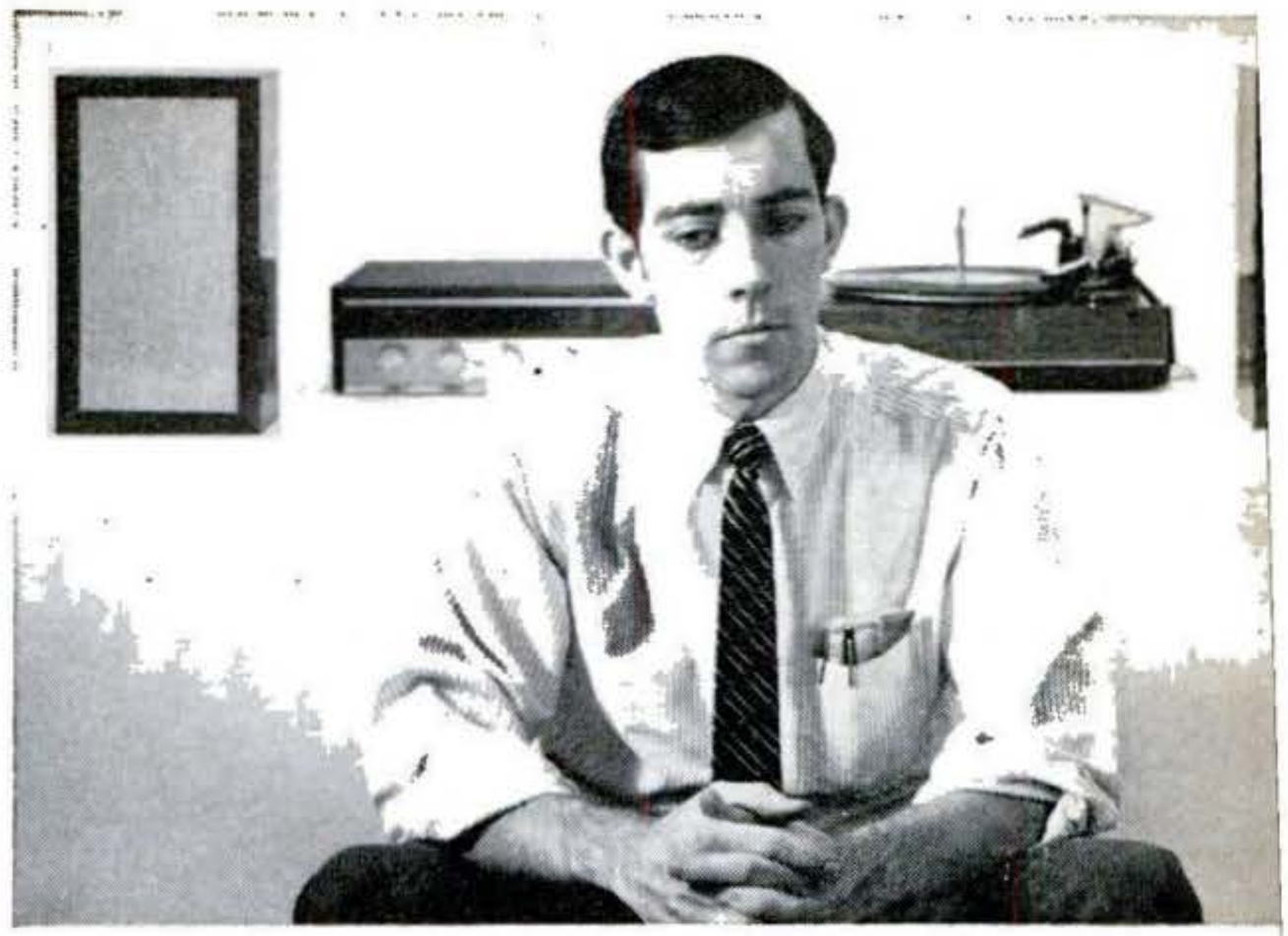
Side 2 is a test record, too. Familiar solo instrument sounds are excellent test signals for gauging the overall distortion that's built into your stereo set. Because you hear the instruments by themselves, you can quickly detect distortion and poor frequency response that might be masked during complicated orchestral selections.

On the other hand, the sound of a full orchestra played at high volume is a rigorous test of your system's ability to recreate the full panorama of sound. With this in mind, the last band on Side 2 contains a rousing orchestral passage.

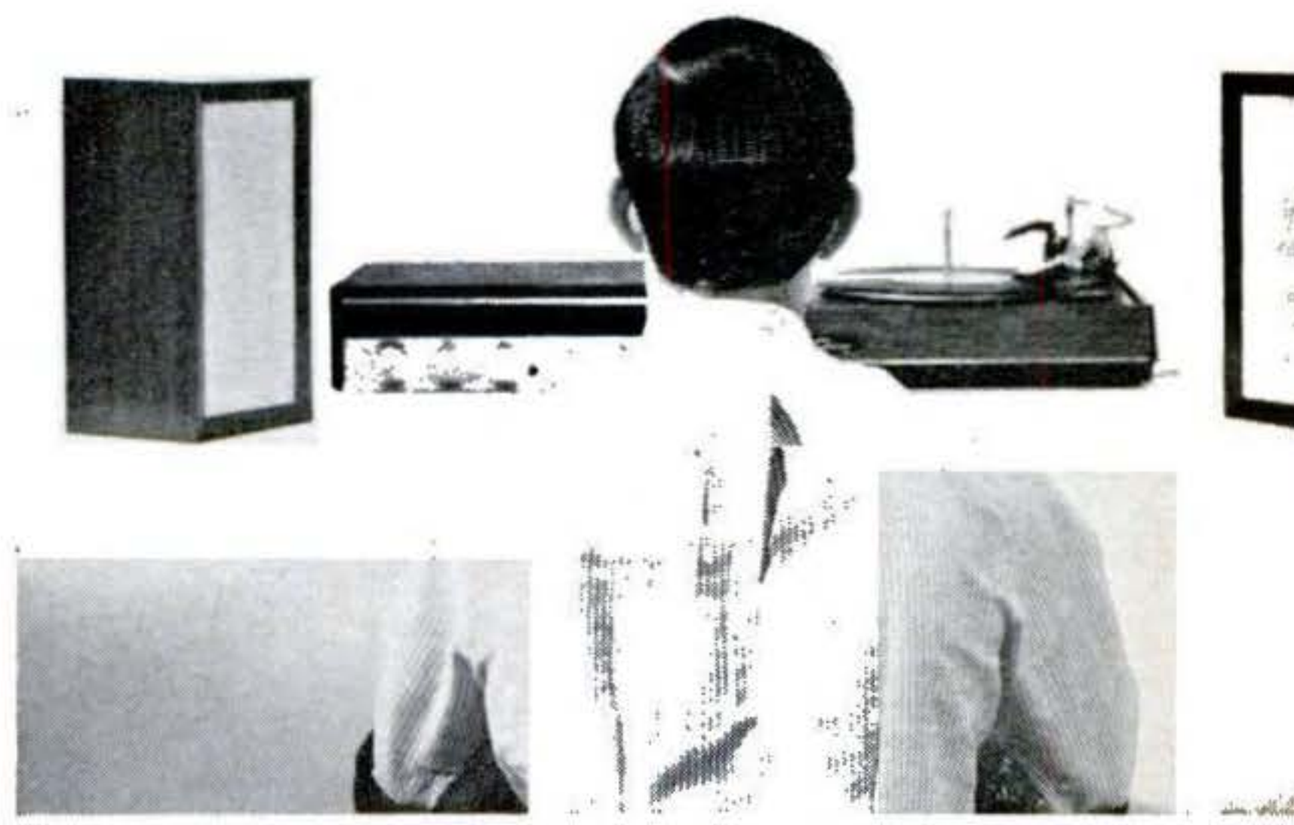
How to use the record. Your ears are among the most sensitive audio-test instruments available. A recorded narration, at the start of each band, tells what you should listen for during each test.

The photographs at the right show three recommended listening postures for use during different tests:

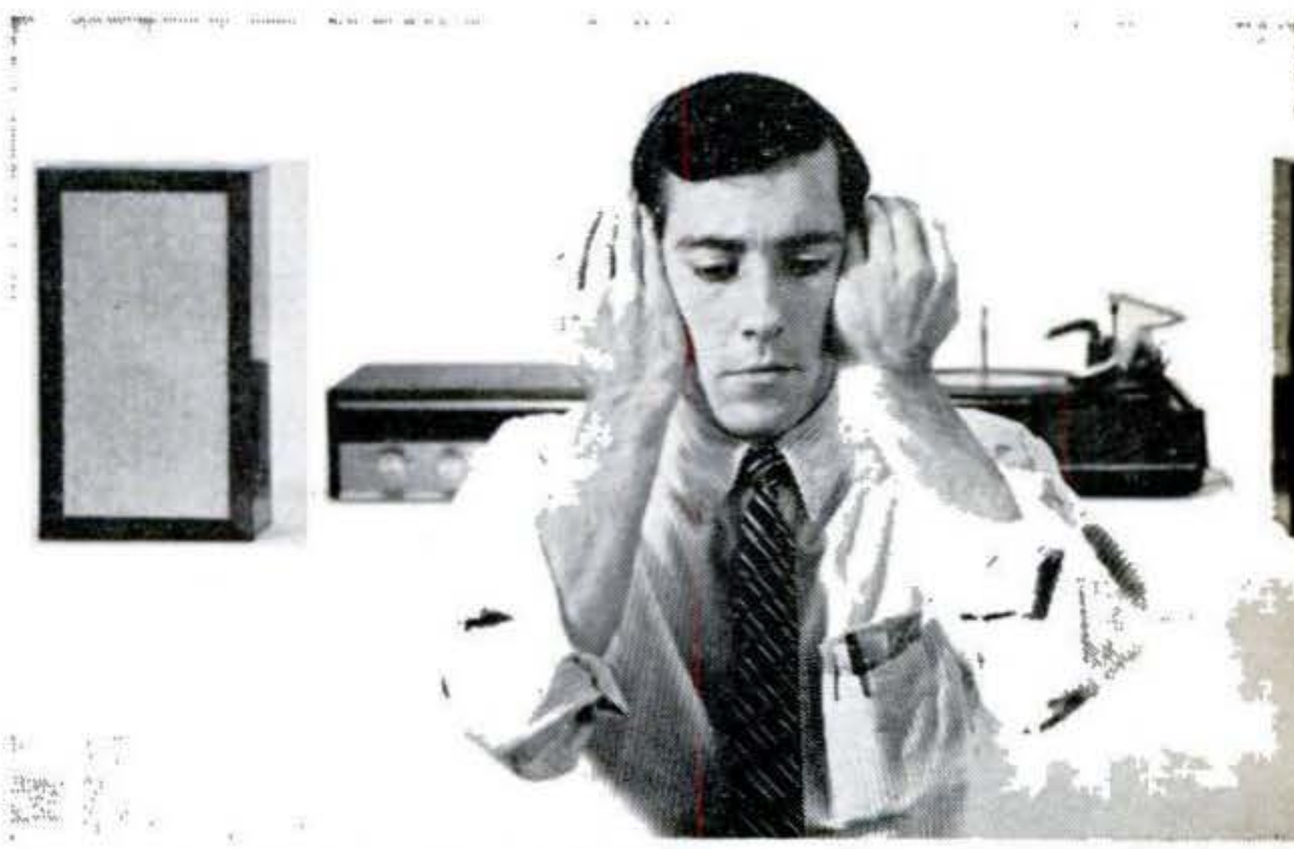
- Normal (top photo). Measure the distance between your speakers—this is how far in front of them you should sit. It makes no difference whether you face away from the speakers, as shown, or look at them. Use this posture for Side 1 tests except speaker phasing, and for all Side 2 listening.
- Phasing test (middle photo). Turn the speakers so that they face toward each other partially. This encourages the mutual cancellation of out-of-phase sound waves from the speakers if they are improperly phased. The cure for wrong phasing is to reverse the speaker lead connections at the rear terminal strip on one of the speakers.
- Alternate normal (bottom photo). If your listening room has excessively live acoustics, or excessively dead acoustics, because of the lack or abundance, respectively, of rugs, drapes, and padded furniture, try this trick: Face away from the speakers and cup your hands to your ears. This tends to cancel the effects of room acoustics so you can evaluate your system's performance more easily. PS



Normal: For most of the listening tests



Phasing test: To detect misphased speakers



Alternate normal: To minimize acoustic effects

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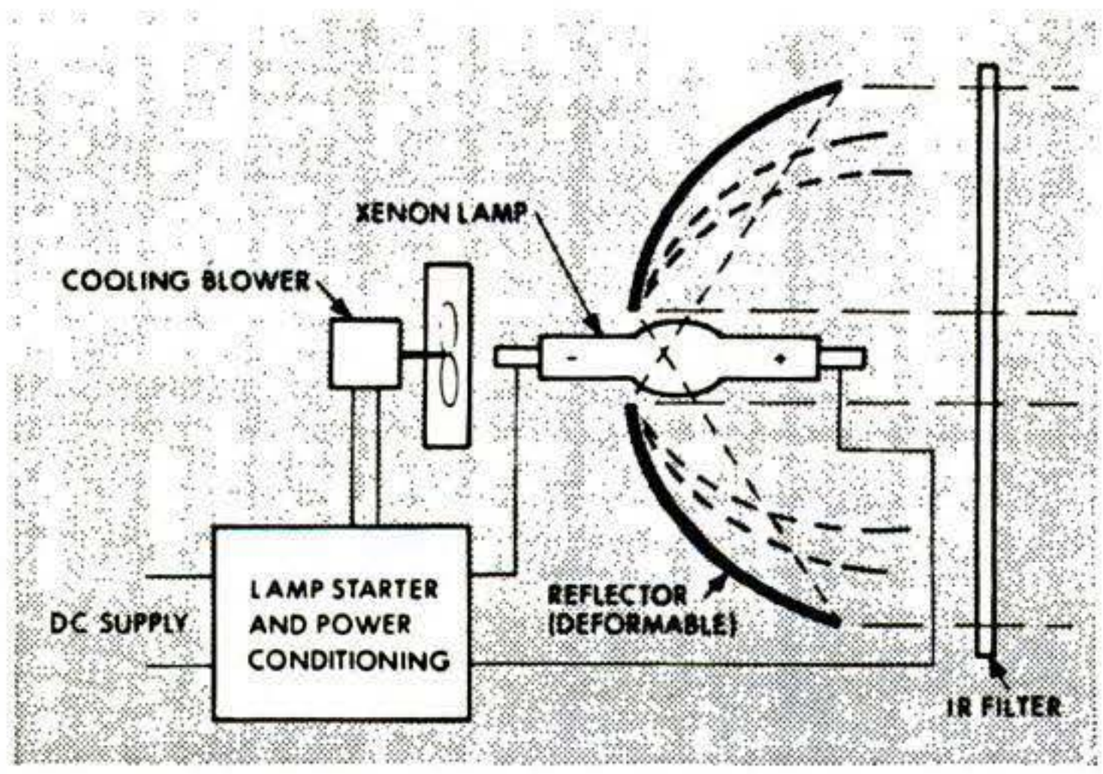
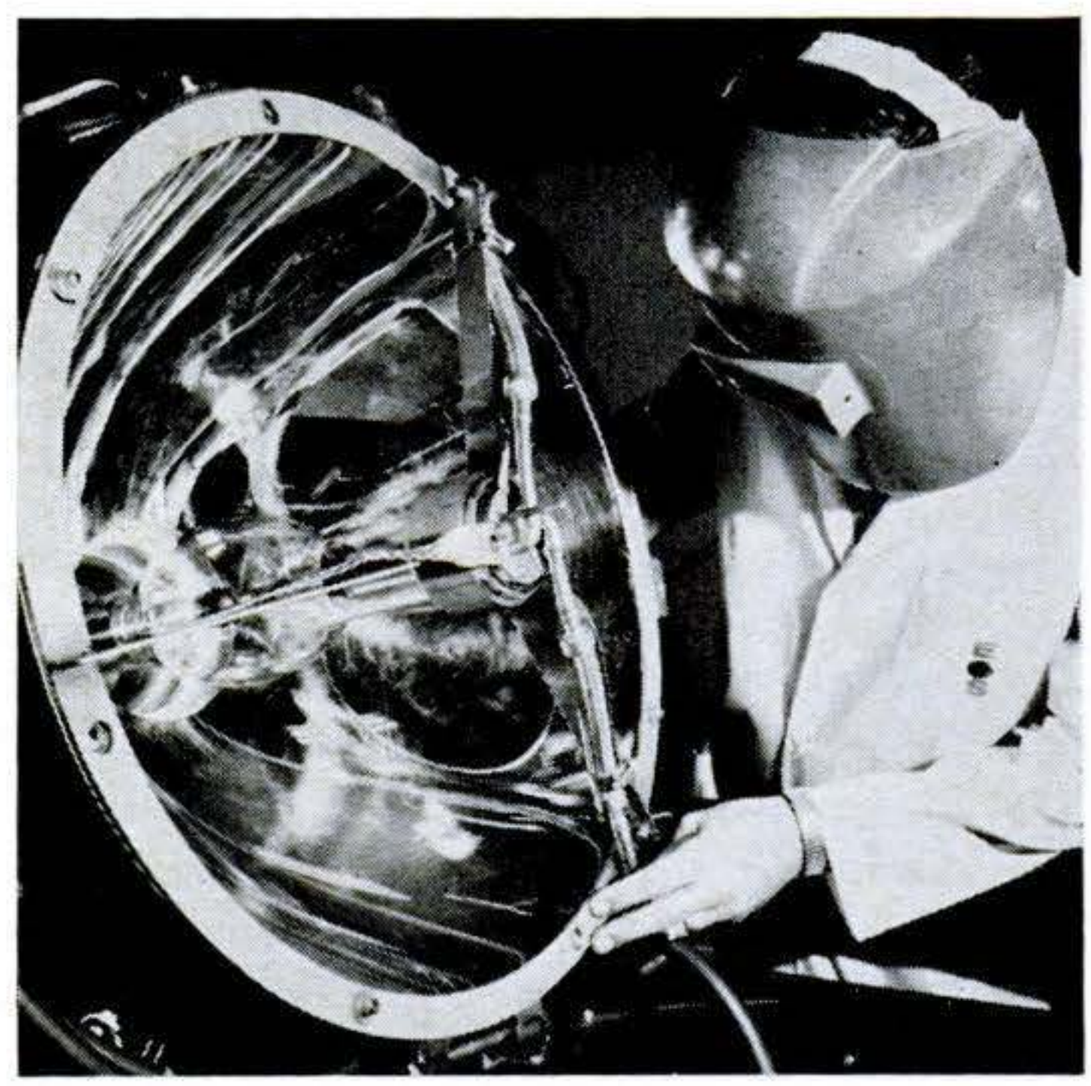
Four-pound Minilight can be used anywhere with its small 16-pound battery pack. It has a range of over 1,000 yards. Like all of the lights, it can be converted to infrared in seconds by pushing a button.



Xenon arc lamps in a nickel electroformed mirror, deformable to change beam shape and width, are common to the searchlights. Blower cools lamp, while a separate package furnishes correct voltage.



Scientist adjusts Airlight, a 500-pound searchlight for ground or tactical airborne use in Vietnam and the most powerful lighting device of its size ever developed. Unit's output is about 600,000 lumens.

Bright lights for Vietnam

A new family of amazingly compact, incredibly brilliant searchlights is lighting up both Vietnam battlefields and crime-ridden city streets.

So light and compact is the smallest, the four-pound, 300-watt Minilight, that it can easily be carried by GIs or patrolmen along with its 16-pound rechargeable battery pack. Despite its small size, it has an output of 1.5 million candlepower and can illuminate terrain for over 1,000 yards. Other uses: aboard helicopters and airplanes and as a rescue beacon for downed pilots.

A second unit, the Junestar, is designed for mounting on vehicles and aircraft, and puts out a peak beam candlepower of more than 50 million. With a 10-inch lens, the 28-volt DC searchlight will fit into a 15-inch cube. The most popular of the new lights for the military, it is also being used for police work.

Largest of the lights is the Airlight, a 20-kilowatt searchlight for air and ground use that has an output of some 600,000 lumens. In tests, it was used to light an entire football stadium with enough intensity for reading purposes. Five hundred 100-watt light bulbs with a power input 2½ times as great would be needed to equal it.

Secret of the new searchlights, made by

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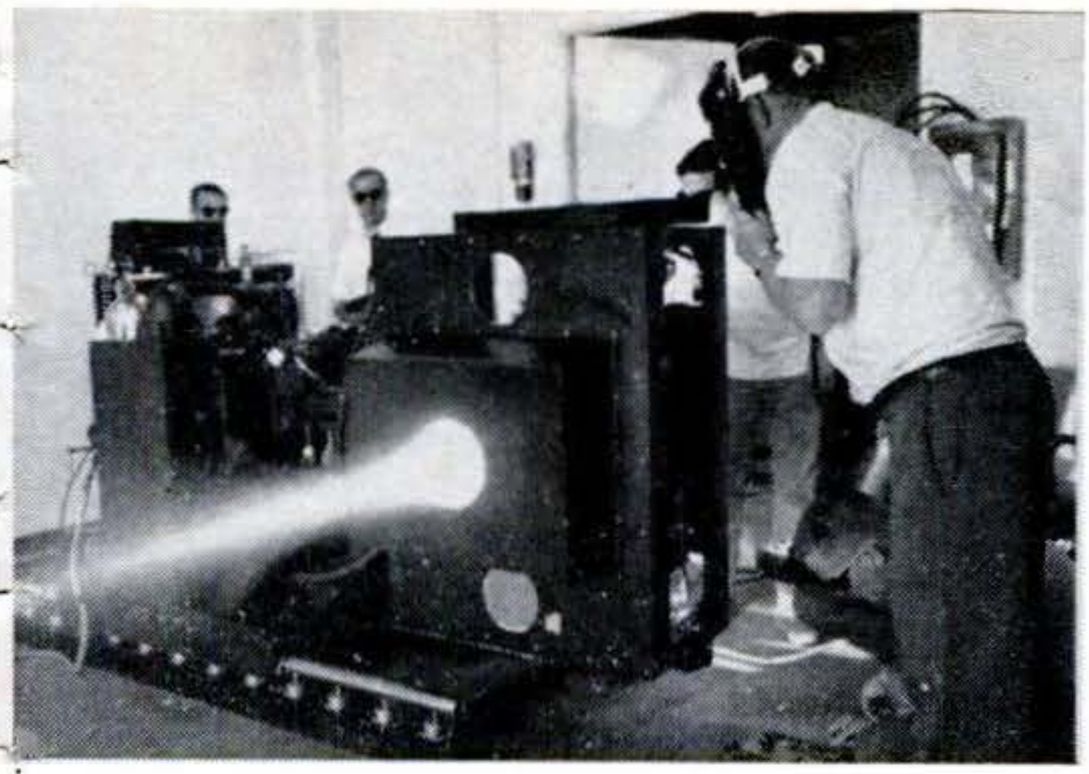

Early version of 20-kilowatt xenon arc lamp undergoes tests. Although searchlights can be converted to infrared, others being developed radiate light for covert illumination and tactical photography.

One-kilowatt Junestar shoots bright beam high into night sky (three beams here result from triple exposure of film). Modest power requirements make it possible to run it from vehicle electrical system.

Electro-Optical Systems, is compact xenon arc lamps consisting of thoriated-tungsten electrodes inside a quartz envelope pressurized with xenon gas. Extremely high arc current, passing through a gap measured in millimeters, changes the xenon to a brilliantly luminous plasma with qualities close to unlight.

Much of the compactness and versatility s in the reflectors. They have a thin skin f highly polished nickel produced in an lectrolytic bath. The reflector is "deformed" o narrow or spread the beam, eliminating he requirement for heavy, expensive additional optical elements.

Bedside TV swings in and out

With this little Sony TV suspended on an arm overhead, a hospital patient can swing it into just the right position to tune in and enjoy a program. Bell Hospital Systems, Bridgeport, Conn., reports that 10,000 such units are now in use in 100 hospitals.

The wonderful six-hoss sleigh

Here's new winter fun—an ice sled powered by a six-horse, four-cycle Lauson engine with a wire-enclosed prop. Drag-type brake and hand-operated throttle control the sled at speeds up to 60 m.p.h.; a rear spring and steel-leaf suspension cushion you on bumps and dips. Ice King is distributed by the Hart M-H Corp., Elkhart, Ind.

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"Inner Space" Rehearsals fo

By DR. WERNHER VON BRAUN

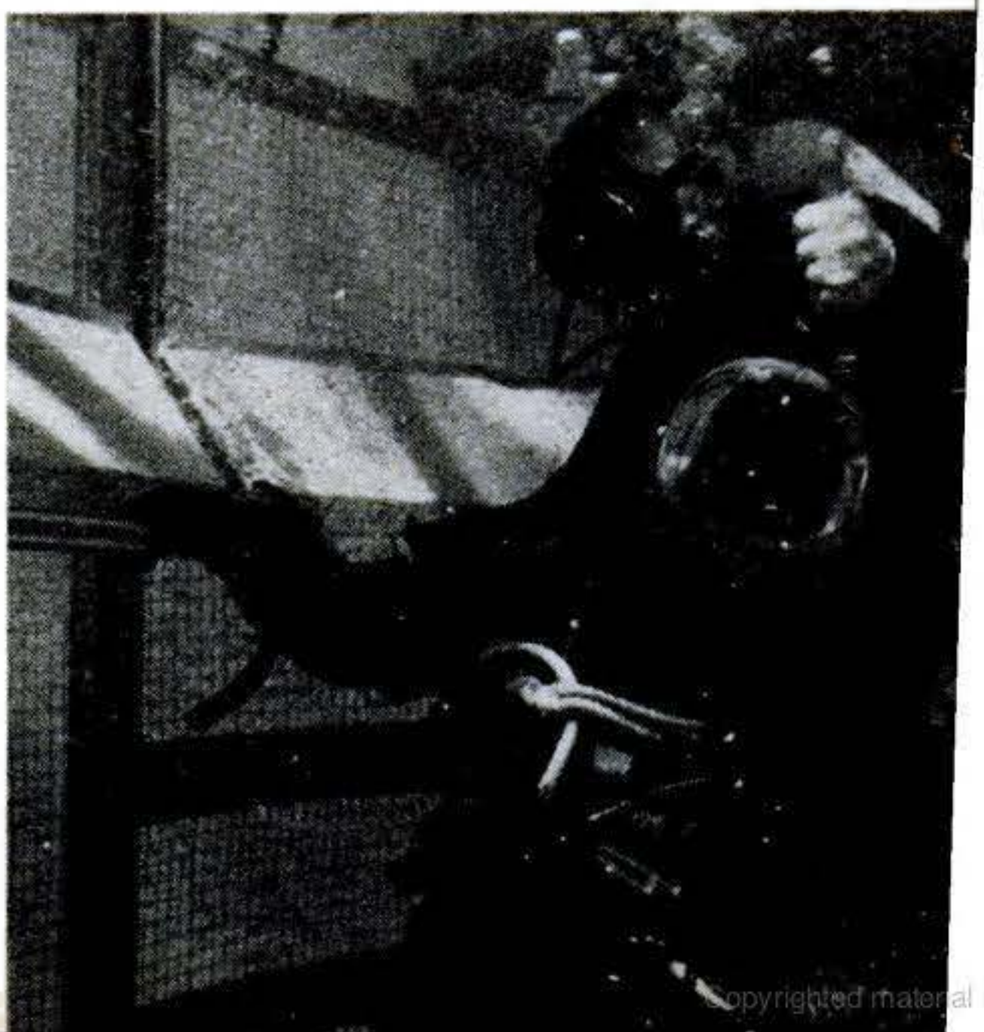
Director of NASA's George C. Marshall Space Flight Center, Huntsville, A

Underwater trials are helping us pl the most ambitious tasks ever la out for our astronauts in orbit.

Coming space-flight missions i NASA's Apollo Applications Progra call for more complex activities und weightless conditions than anything ev attempted in the Gemini program. A tronauts will have to move equipme around and operate elaborate apparat in scientific and technical experiment They will live and work together in first-generation space station consisti of units brought together by rendezvo and docking in orbit. They will have emerge from their pressurized home casionally—to replace a film cassette, just to fix something.

Engineers preparing these new m sions, in close cooperation with the

Dr. von Braun dons lead-weighted spacesuit (to try out Neutral Buoyancy Tank—and feels heavy as if on planet Jupiter, before he enters ter. Submerged (below), he maneuvers in full-s mockup of a portion of Orbital Workshop—a "li room" in space—with a scuba diver close beh



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To plan and practice coming tasks in orbit, our astronauts are simulating zero gravity under water—and the distinguished author, trying it for himself, tells here what it's like

Outer Space Adventures!

Underwater trials test foot and hand holds of a floor grid for Orbital Workshop. For safety, two scuba divers keep eye on spacesuited test subject.

tronauts who will fly them, must see that every piece of equipment is designed to suit the conditions of its use; that a mission's plan gives the astronauts ample time for what they are to do; and that they do not overexert themselves to perform their tasks.

Aircraft flights through "ballistic parabolas" have long been used to study human-engineering problems under zero gravity, and will continue to be tremendously useful. But weightlessness during ballistic aircraft flights is limited to less than a minute—too short for many of the complex tasks planned for the Apollo Applications Program.

All tasks requiring more time are therefore being studied in underwater tests—an idea pioneered by the astronauts themselves. Astronaut M. Scott Carpenter, the second American to orbit the earth, first pointed out the great potential of this way to study human-factors problems under zero gravity. Astronaut Eugene A. Cernan first tried it in a spacesuit. And Astronaut Edwin E. ("Buzz") Aldrin Jr., who rehearsed in a swimming pool for his successful space rigger's feats outside the orbiting Gemini 12 spacecraft, gave the final proof that underwater time, work, and motion studies in "inner space" really paid off handsomely in outer space.

Test tanks for space centers. Underwater simulation facilities, elaborate but relatively inexpensive, have been set up at NASA's Manned Spacecraft Center in Houston and its Marshall Space Flight Center in Huntsville. A test subject wears a standard spacesuit, weighted down to give him neutral buoyancy when he submerges in a tank of water.

He works on a full-scale mockup of a particular orbital installation, or a part of it, also submerged in the tank. Examples of what the mockup may represent are given by the three most important orbital-flight missions under the Apollo Applications Program:

- An Orbital Workshop, adapted from an S-IVB rocket stage, to study long-term habitability of an orbital "living room" and to conduct biological, physical, and technical studies under zero gravity.
- The Apollo Telescope Mount, an observatory with astronaut-operated instruments to study the sun, which I described last month in PS.
- A manned satellite, carrying an astronaut-operated array of remote sensors and multi-spectral cameras, to study advanced earth-resources survey methods.

To reduce water resistance in narrow passages, the mockup is an open-grid structure that permits water to pass freely through its walls. The upper side of a mockup has escape hatches that, pushed open from beneath, give free access to

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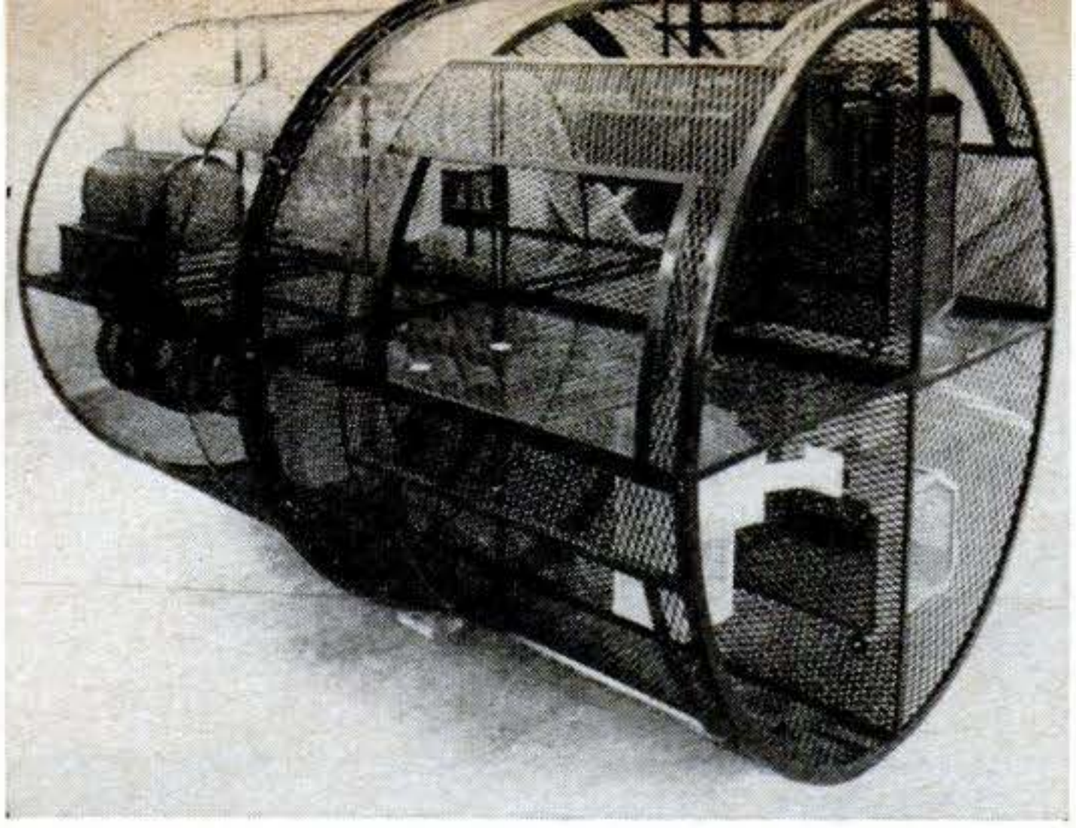

Open-grid walls of mockups keep subject's movements from being hindered by water resistance. This seven-foot-diameter mockup is of telescope tube for the projected Apollo Telescope Mount.

the water's surface in an emergency.

Trying it out. To familiarize myself with some of the astronauts' tasks and get a feel for their difficulties, I recently spent about an hour in the Neutral Buoyancy Tank at Marshall. I tried my hand at relatively simple jobs, such as placing a cover over a vent outlet, that are involved in "activating" the Orbital Workshop (which, prior to human occupancy, will have served as a hydrogen tank).

Before donning the pressurized spacesuit, I was wired up so that an outside observer could monitor my heartbeat and breathing cycle. This, I learned, was not only a safety measure against possible equipment failure or overexertion. It also provided a direct measure of my physical effort to perform a given task.

Effort data play a key part in the flight mission's ultimate "time-lining"—an important new word in space lingo that you may want to remember. It means working out a timetable for preparing and executing each task, for rest periods in between, and so on. With unrealistic time-lining, a space mission will either waste costly orbital man-hours for lack of enough to do—or it will hopelessly slip behind schedule, and many experiments prepared and carried into orbit at great expense will remain undone. Realistic time-lining demands the best data available.

After I was zipped up in the spacesuit and topped by the space helmet, a lead-weighted belt was thrown over my shoulders, and lead-weighted straps were fastened to my ankles. As I got up from my dress-up chair, I felt as if I had landed on the 2½-g surface of the planet Jupiter. But the load lightened when I entered the tank, where I first stood on a platform that kept me shoulder-deep in the water.

Now the pressurization of the suit began. They had strapped a dual pressure gauge to my wrist. The test controller, whose voice I heard over the helmet earphones, asked me to call out the suit pressure through my helmet mike. At a suit overpressure of 3.5 pounds per square inch, I was ready for underwater action.

Two scuba divers, who for safety always stay close to a test subject, gently inched me off the platform. They rotated me in a horizontal position, submerged and free-floating, to make sure I was properly weighted down to neutral buoyancy. I was. (They must have gotten my exact vital statistics from the Center doctor—or a fine retrim would undoubtedly have been necessary.)

My awkward attempts to perform the assigned tasks must have been as amusing to onlookers, below and above the waterline, as they were educational to me.

I was particularly impressed by the "straitjacket" effect our spacesuits still have. It takes physical force to bend your arm, because the internal pressure of your spacesuit wants your arm to be straight. The pressure also pushes your arm up around the shoulder joint, and it takes a certain effort to bring it down to your ribs.

A wrestle with a valve cap. One of my tasks was to push a hubcap-size cover over a valve, and secure it by a turn to the right—just as you would tighten the cap of your car's gas tank. As I tried to push and twist the cap into place, the reaction force turned me around instead. I anchored myself, with one hand, to a handhold provided near the work station—but found it awfully difficult to do the pushing and the turning with the other hand alone. After a minute of real hard physical effort, I was panting heavily and had to rest a bit.

Undoubtedly a few more hours of practicing this particular task would have enabled me to lick it. But I decided right then and there that the designers of that darn cap might as well take a course in basic physics, or try it in the

[Continued on page 208]

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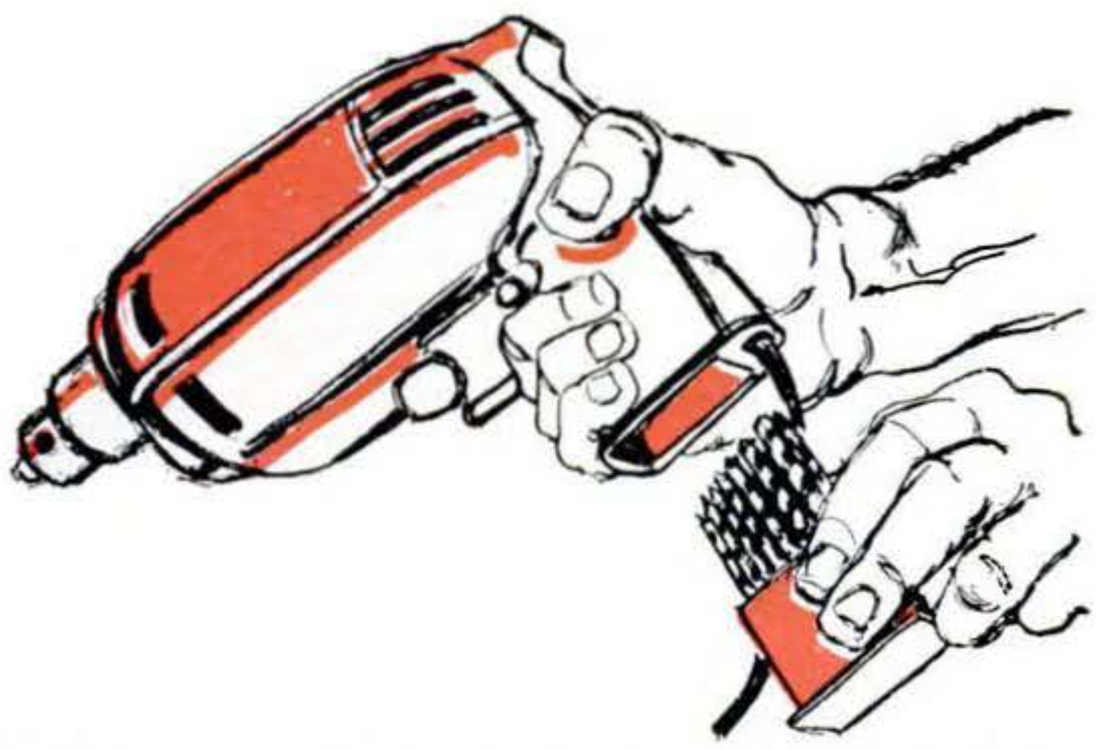
"I'd like to see them make..."

DRAWINGS BY DANA RASMUSSEN

Tip-down gutters on today's low-roofed ranch houses so leaves, dirt, and wind-blown debris could be easily dumped or pushed out. —*M. Mirante, Chicago.*



Drills with a bit case that would slide into the handle like a cartridge magazine in a pistol. Then, where the drill goes, the bits go, too.—*David Lection, Pittsburgh.*

A tape-recorder clock-radio combination. You'd set the clock to turn on the radio and recorder to tape a program you're not home to hear.—*Robert Wong, San Francisco.*

Automatic bedroom windows with controls that could be set to open or close them at a specified time or on reaching a specified temperature.—*Paul J. Illk, Saugus, Calif.*

Radio jacks in the armrests in the rear of cars. Then a driver who didn't want radio could let his passengers listen in on earphones.—*Curt Fields, Richland, Wash.*

Everyone has his own pet idea of a gadget that he would like to see in general use. What's yours? We will pay $5 for each one published. Please use Government postcards only. Send to ILTS Editor, Popular Science, 355 Lexington Ave., NYC 10017. Write your name and address clearly. Contributions cannot be acknowledged or returned.

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Rotadipper lights on Pat Martin's Mini pivot 42 degrees at full lock and also tilt downwards.

Eyes-right headlights pick out a rooftop ramp in British multideck car park, showing exact pa

Steerable Headlights Swing Wide and Down

By DAVID SCOTT / *PS European Editor*

Want headlights that steer around corners, hold the beams on the white line on curves, don't glare across the road at oncoming drivers, and can be aimed down with a fingertip lever to place the light exactly where you want it?

These amazing Rotadipper lights were designed by Pat Martin, an English car dealer, and sell for about $70 in kit form.

Control lever dips headlight 10 degrees below horizontal with fingertip movement of right hand.

They'll soon be adapted to U.S. lighting regulations and become available in this country.

The basic idea is simple yet ingenious. Martin replaced the seven-inch headlights on his BMC Mini with bolt-on plastic shells housing standard 5.75-inch units. These are clamped in stainless-steel rings with swivel pins top and bottom. The assemblies are enclosed by clear molded domes.

Sideways aiming of the light is controlled by a compound lever linked to the track rod via a swinging lever and rotating shaft. But the lights not only swing from side to side with the steering wheel—they anticipate the turn, swiveling to a greater angle than the front wheels when you enter a turn. They shine around the corner before you get there, then slacken their movement to let the wheels catch up.

But there's more: As the unit swivels to one side, it also tilts down progressively, lowering the beam as the steering angle increases, for close-in illumination of curbs and shoulders.

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Headlamp unit shown at right pivots inside plastic housing, progressively angled by a compound lever linked to the steering-track rod. Cam-action levers are located on underside when installed in car.

on Turns

These geometric antics come from a clever arrangement of levers and cams on the underside of each plastic housing. The first of two levers, positioned by the rotating shaft, has a fixed pivot. A peg on its outer end slides in a slot in the second lever, which is bolted to the lower swivel pin on the clamping ring.

As the first lever moves with the steered wheels, it gives a differential cam action against the second lever. The slotted lever swings rapidly at the start of a turn because the peg is then at the inner end of the slot—close to the fulcrum. Swing rate slows as the angle increases, for the peg then slides out towards the end of the slot, lengthening the lever arm.

Downward tilting is crafty, too. The lower swivel pin is lodged in a longitudinal slot in the plastic housing. When its T-shaped operating lever is swung to one side, one of the outer corners of the T wipes against the housing flange, levering the bottom of the unit back against a spring.

If that isn't enough, you can also tilt the units by hand through a 10-degree angle. This lets you get ready for a humpbacked bridge or tricky driveway, or correct for tail-loading.

How's it done? The upper swivel is supported by a metal slide seating in a T slot molded into the top of the housing. Sheathed cables connect the two slides to a cranked lever below the steering wheel. The horizontal aiming is fail-safe. If anything breaks in the linkage, the lights are spring-loaded to self-center straight ahead.

So far Martin has produced kits for the Mini, MG 1100, and Ford Cortina. To comply with U.S. regulations, Martin says a four-light car can be readily adapted to take two of the present Rotadippers with modified housings. For two-light cars he figures that seven-inch swivelers will be possible. In both cases, the installation of sealed-beam units will be no problem. Martin is tooling up for this market. If you want to know more, write to Fred Bauer, Intercontinental Aviation Services, Inc., Box 1705, Beverly Hills, Calif. 90213.

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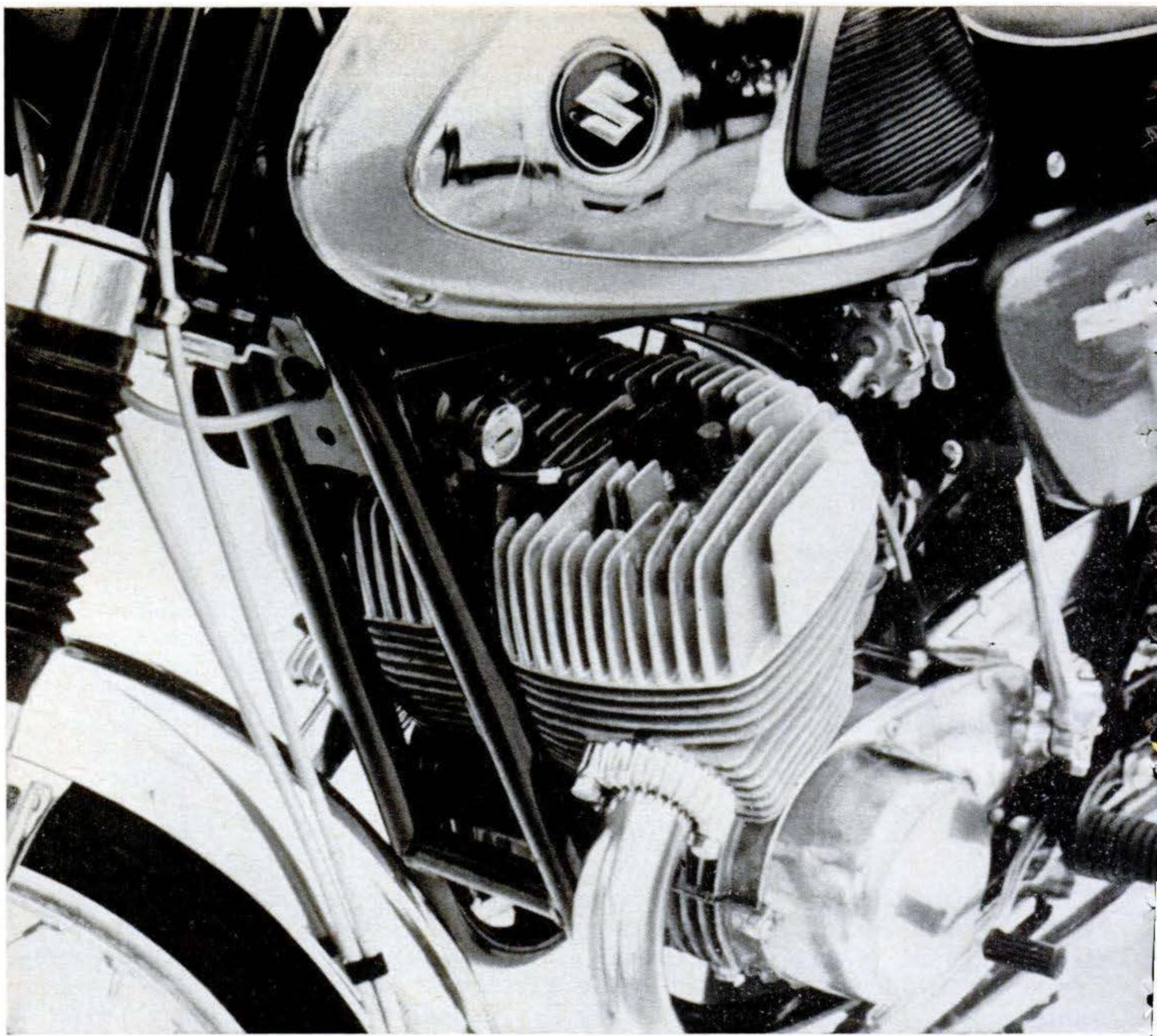

Does your motorbike need a tune-up? You can do this easy and pleasant job yourself in an afternoon or two

How to Tune Your Motorcycle Engine

By RICHARD DAY

When your lightweight bike gradually gets a little harder to start, a little slower on the getaway, and puffs a little harder when headed uphill, the time has come for a tune-up.

Most lightweight bikes have two-stroke engines, and most of the things I'll tell you about here apply to two-strokes. However, I have added a few items that will help you tune even a four-stroker.

Tuning a lightweight motorcycle is as easy and pleasant mechanical work as

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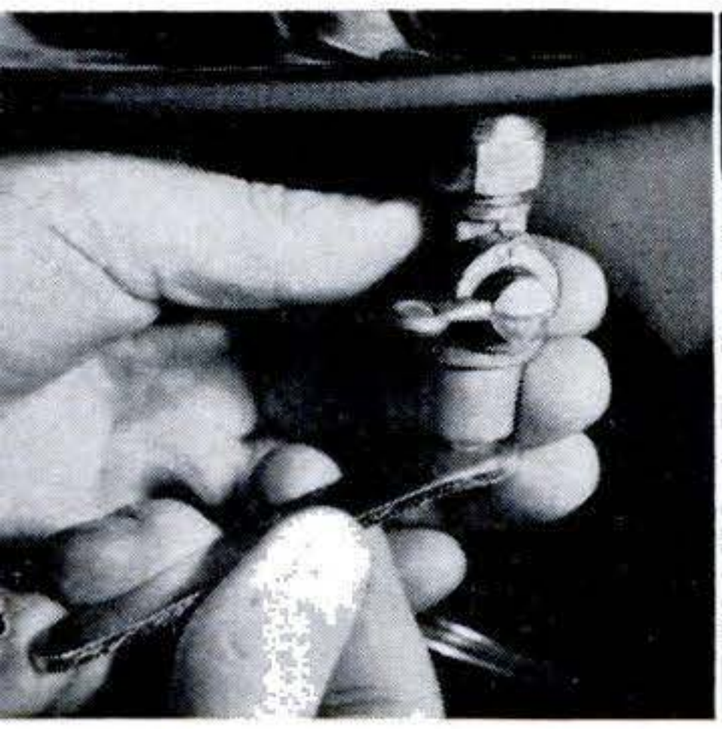
Most of the tools you'll need come in your motorcycle's servicing kit. A kit usually contains pliers, screwdrivers, an assortment of open-end wrenches, and a spark-plug socket. A few extras are advisable, such as a 10mm socket and adapter to fit your present socket handles, a set of thickness gauges (for four-stroke engines), and a nonmetallic breaker-point file.

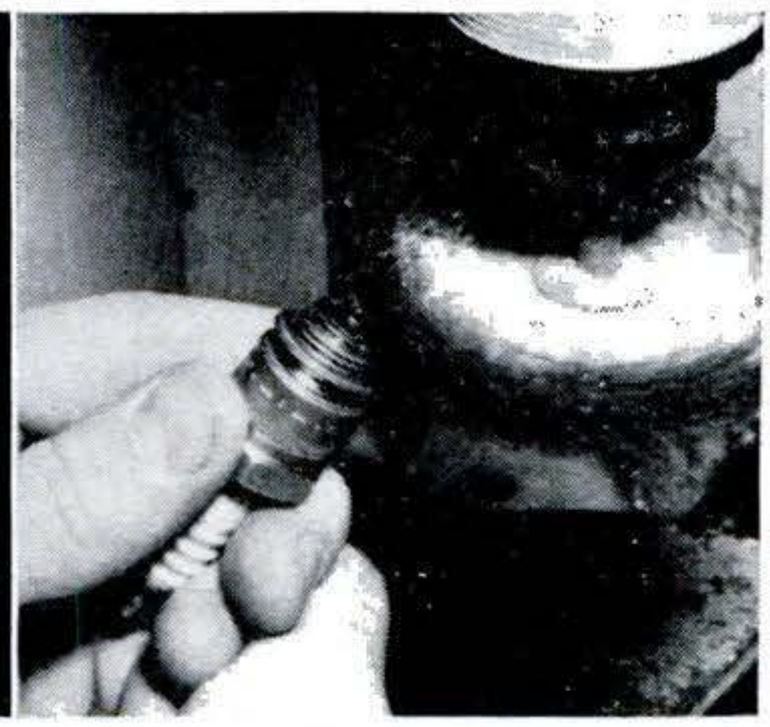
you've ever done. Just one word of caution: Stay out of the crankcase. Motorcycle dealers get a lot of basket cases because the owners tried to dismantle their own crankcases. If your bike needs service inside the crankcase, see your dealer about it.

There are no problems about removing and replacing the cylinders. Usually only four small nuts hold a cylinder to the crankcase. With the accessories removed and the nuts off, the cylinder lifts away. Nothing to it.

Replacement is just as easy, because there's a chamfer around the bottom skirt of the cylinder to help you stuff the rings back in their grooves. The only thing to watch is that the right ring is in the right groove, right side up; and make sure the ring ends are on either side of their locat-

Continued





uel **strainer** is usually located ıst below the fuel shut-off valve nder the tank. Water, dirt, and ther impurities collect in the rainer and can hamper a steady ow of fuel to the carburetor. Reove the strainer bowl, washer, nd screen, and clean them in solnt. Next, remove and clean the r filter—usually a paper element. se no water or solvents—just ow compressed air from inside.

Examine the spark plug after a five-minute run at near top speed with immediate shutdown. The insulator around the spark plug's center electrode should have a light tan color. If it doesn't, you probably have a plug of the wrong heat range. It it's white or blistered, replace with one that's one step colder. If there's carbon or sludge on the insulator, replace with a plug that's one step hotter.

Easiest way to clean a spark plug: Hold the business end of the plug against a rotary wire brush in a drill press or an electric hand drill. Lacking a drill, you can clean the plug with a penknife after soaking in solvent. For two-stroke engines, it's a good idea to carry a spare plug with you at all times, since the plug is the most common cause of trouble. Plugs usually live longer in four-stroke engines.

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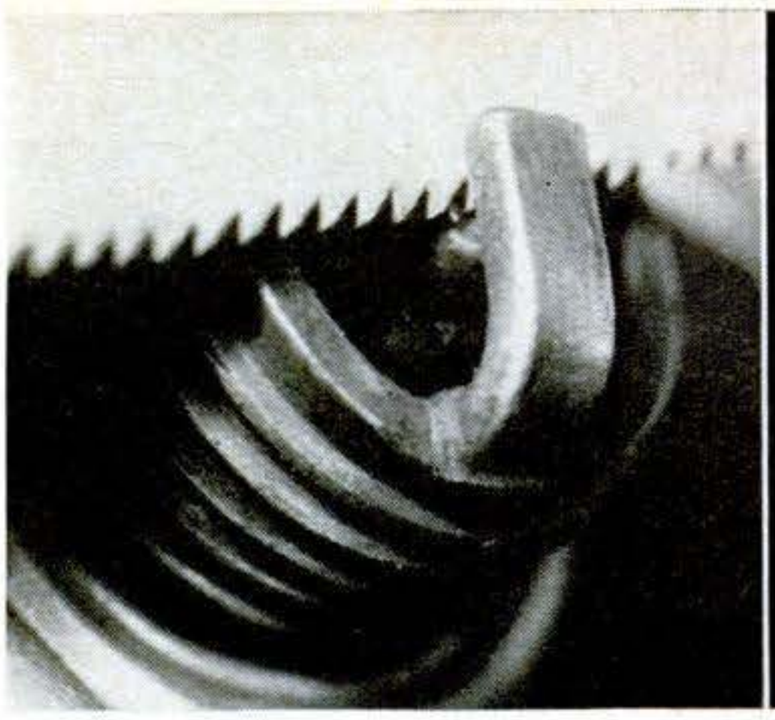
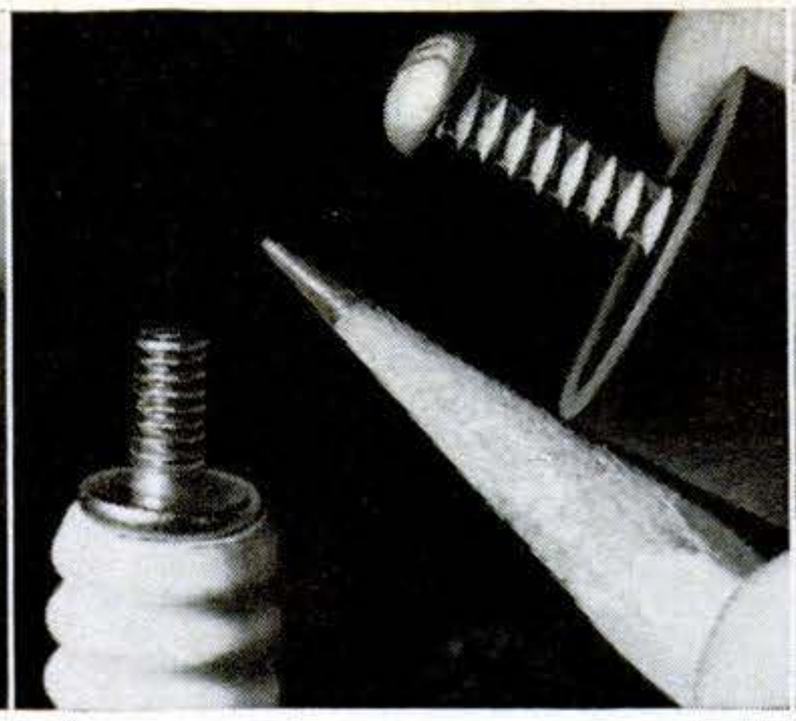
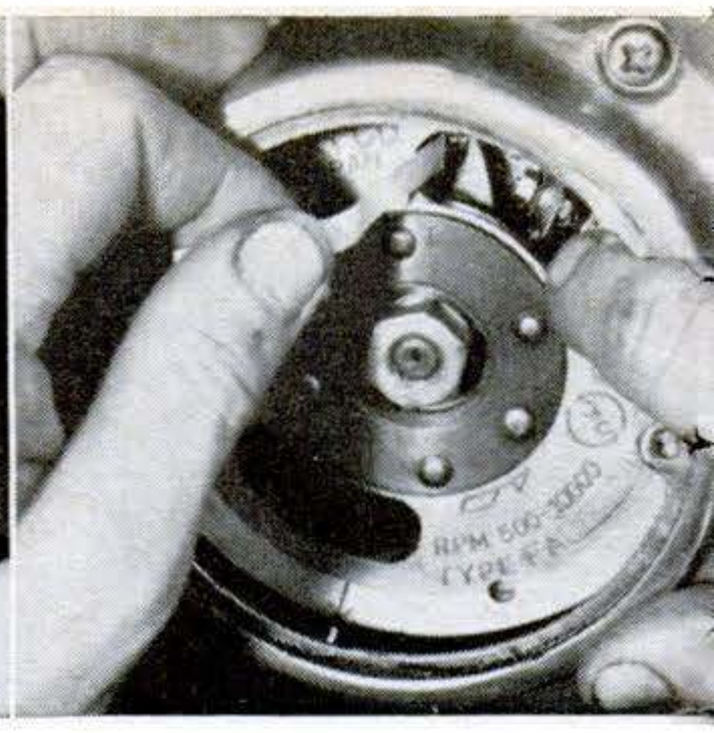


Spark-plug gap surfaces must be scraped or filed bright and clean. Use a flat file first, then a hacksaw blade. Seesaw the blade through the gap—this will leave sharp edges that make it easier for the spark to jump the gap, and your engine will fire quicker. Gap the plug according to the maker's recommendation (using a thickness gauge). The next step is to check for ignition-system polarity.

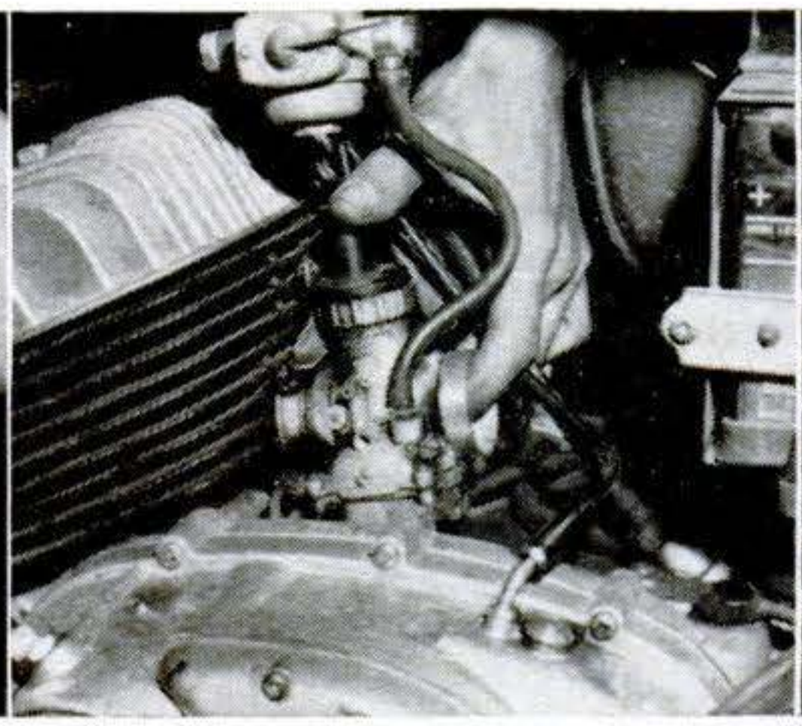


Check ignition-system polarity by holding a pencil in the path of the spark between the hot line and the plug terminal. The spark will kick out a little graphite and leave a reddish tail on one side of the pencil. The tail should aim toward the terminal. If the tail is on the hot-wire side, the coil leads should be switched around. Polarity can make a 30-percent difference in the firing ability of the plug.

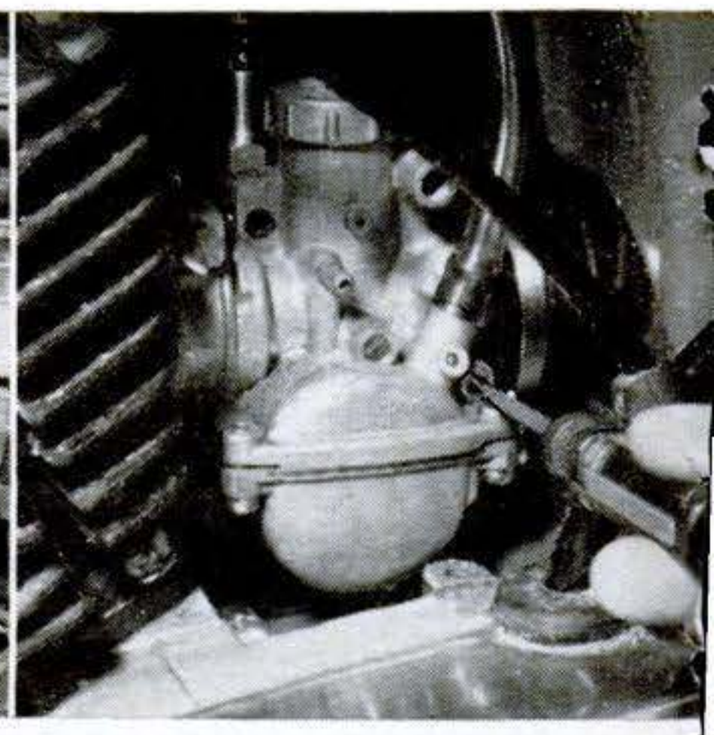


After cleaning and adjusting th points, set the timing. Insert piece of cigarette paper betwe the points and turn the flywhe slowly past the timing mark. S the gap so the paper can be pulle loose just as the timing marke passed (indicating firing). Th point gap must be set as specifi by the factory, usually .012" .016". Twins normally get sep rate adjustment for each cylind

Valve-tappet adjustment is part of tuning a four-stroke engine. Remove valve cover and spark plug. Turn piston to top dead center; both valves are then closed. Insert the proper thickness feeler gauge between the valve stem and the rocker-arm-lever pad. The feeler should slide in and out under light drag. To adjust, loosen the tappet locknut and turn the adjusting screw clockwise to open.



Synchronize carburetors (if you have a twin). Remove both of the rubber air ducts to the carburetors and stick a finger into the throat of each carb. Roll the throttle with the other hand and feel the slides move up the carburetor bores. When one slide reaches top, check that the other one is in exactly the same position. If not, adjust one or the other by turning the cable adjustment on the slide cap.



Most bike carburetors have th adjustments. One anchors main jet needle low, high, or between (this must be done w the carb dismantled). The seco is the throttle-stop screw wh controls idle speed. It should be for slowest possible idle with a p warmed engine. The third (abo is the air-adjusting screw. Se so the engine runs its smooth listen to exhaust rhythm.

ing pins when you slip the cylinder over them. The pins keep the ring gap from becoming positioned at a port.

If the piston is removed for cleaning, mark the front with a felt pen so it can be replaced the same way.

In reassembly, the cylinder and head nuts should be torqued down in pattern, tightening each one a little more in turn until specified torque for all is reached. A common torque spec is 90 inch-pounds for engines of 100cc or less, and 180 inch-pounds for larger engines. Those are *inch*-pounds, remember, not foot-pounds.

The best place to start any work on your bike is the owner's manual. Many tuning operations are described in it zeroed in on your machine. If you don't have a manual, write the distributor, giving the model number of your cycle

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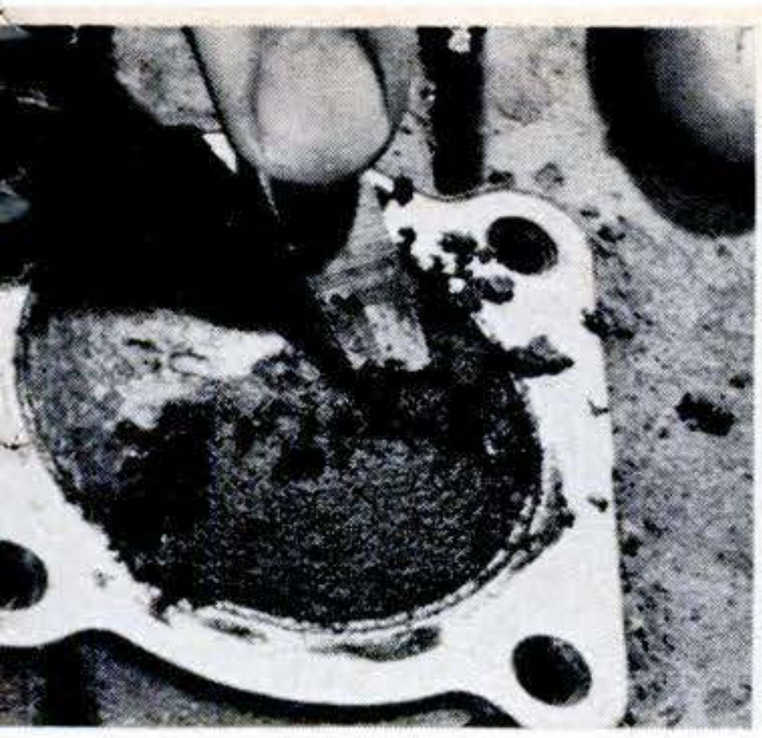
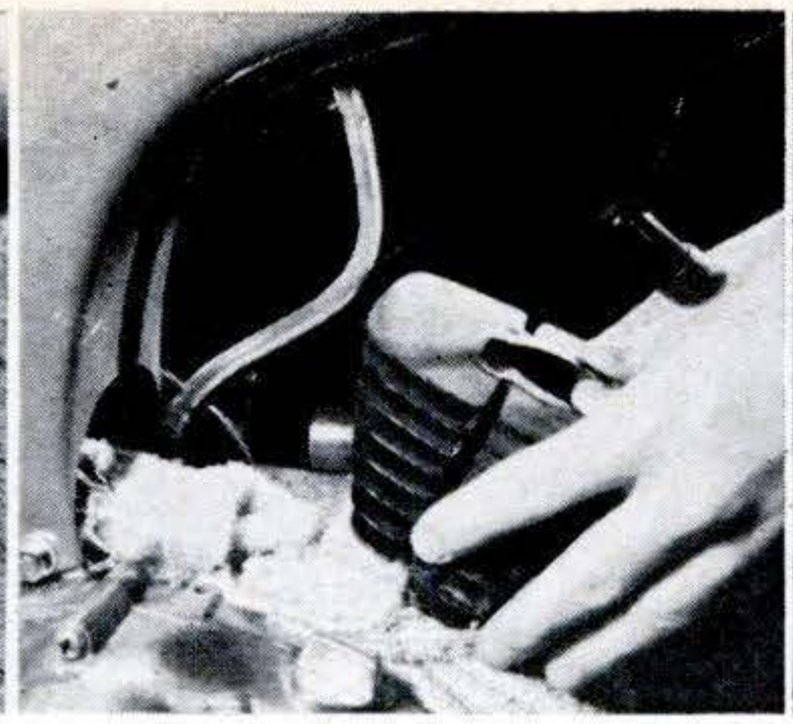
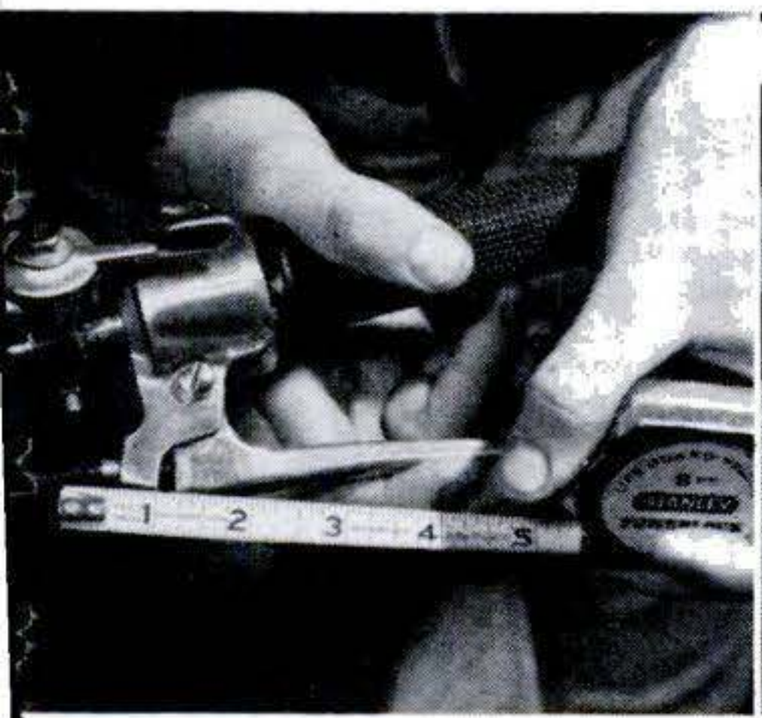


Decarbonizing becomes necessary much sooner in two-stroke engines than in four-stroke units. Remove the cylinder head, move the piston to top dead center, and scrape carbon from the top of the piston. Be careful not to gouge into the piston crown, as this might leave scars in the metal and cause preignition. As a final step in the process, wipe the piston clean with a cloth wetted in gasoline.

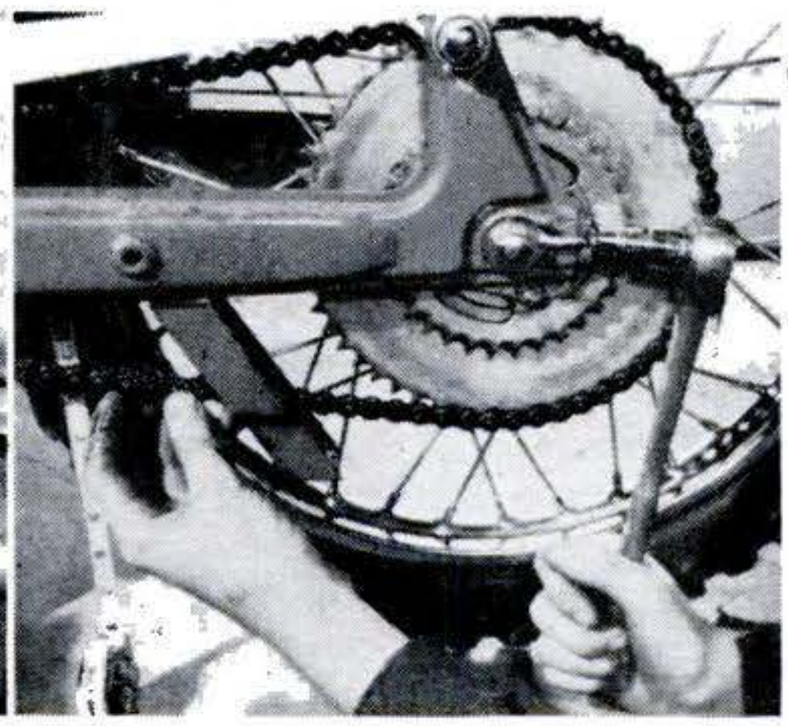


Remove carburetor and exhaust pipe. Then unscrew the nuts that hold the cylinder on the crankcase. Move the piston to top dead center and lift the cylinder slightly; then stuff clean rags underneath to keep dirt out of the crankcase. Turn the crankshaft until the piston reaches bottom dead center (watch the rags) and pull the cylinder off. Be sure to scrape all carbon away from the ports.

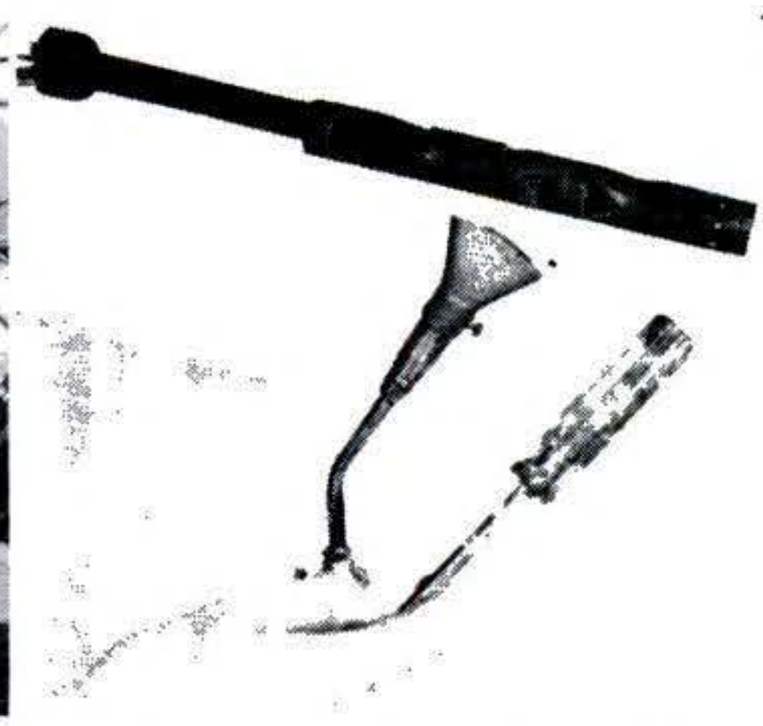
To decarbonize piston rings and ring grooves, remove each ring carefully by spreading the ends just enough to get them clear of the piston top land and lifted off. If you spread the ring gaps too much, the rings will break. Remember which ring came out of which groove and which side was up, so you can replace them correctly. Clean the ring grooves, and put the clean rings back in place.



Clutch-cable play should be set according to specifications for your machine. Some are adjusted by turning a clutch-pressure screw, with a locknut. Others are adjusted by increasing or reducing play at the cable end fitting on the cover housing. Either way, make sure that the clutch fully disengages when the handle is pulled all the way, while applying full pressure when the handle is released.



Remove and clean the chain by soaking it in gasoline. When refitting it, check chain tension (usually 5/8" to 7/8" of total play measured up and down midway between sprockets). Most cycles have fittings for positioning the rear wheel and maintaining chain tension. Check wheel alignment—the rim should be centered between the frame members. Spin the wheel to check brake drag.



Decarbonize the muffler—particularly important in two-stroke engines, where cylinder scavenging is dependent on proper exhaust tuning. Remove the baffles and wash them thoroughly in warm, soapy water. If they are badly carboned up, burn off the carbon with a propane torch and tap the baffles to knock off the burned ash. It is advisable to decarbonize the entire exhaust pipe as well.

Most manuals show the various steps of tuning as a definite maintenance program with specific intervals. This is great if you bought your bike new. Otherwise, it may need tuning right now.

Good tuning is an overall product, which includes carburetor cleaning, decarbonization, spark-plug and point replacement, and ignition timing. The jobs should be tackled in that order.

In addition, you should give attention to minor checks and adjustments on the machine. These include chain, clutch, brake adjustments, and cable settings.

With the right tools and the correct specifications, you can put the zap back in your lightweight motorcycle in surprisingly few hours of work. Your reward is better performance—and the satisfaction of a job well done. PS

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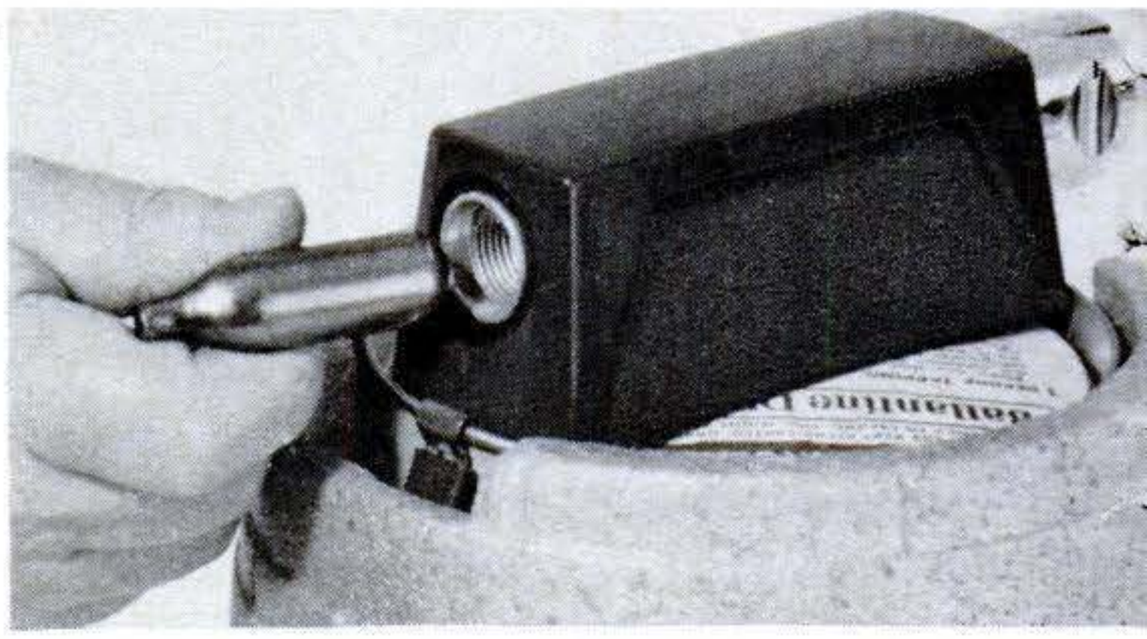
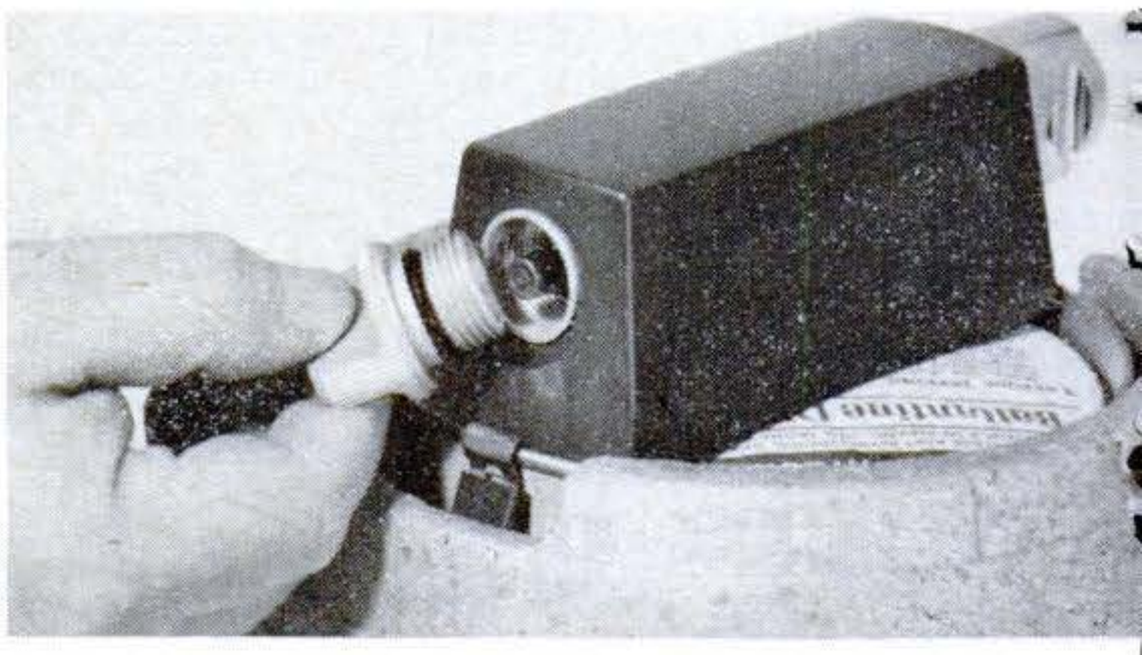
Step one: Insert stainless-steel draw tube of Draft Beer Tap through rubber stopper in gallon can.



Step two: Press down tap until it clamps to can's rim, and insert familiar CO_2 cartridge in opening.

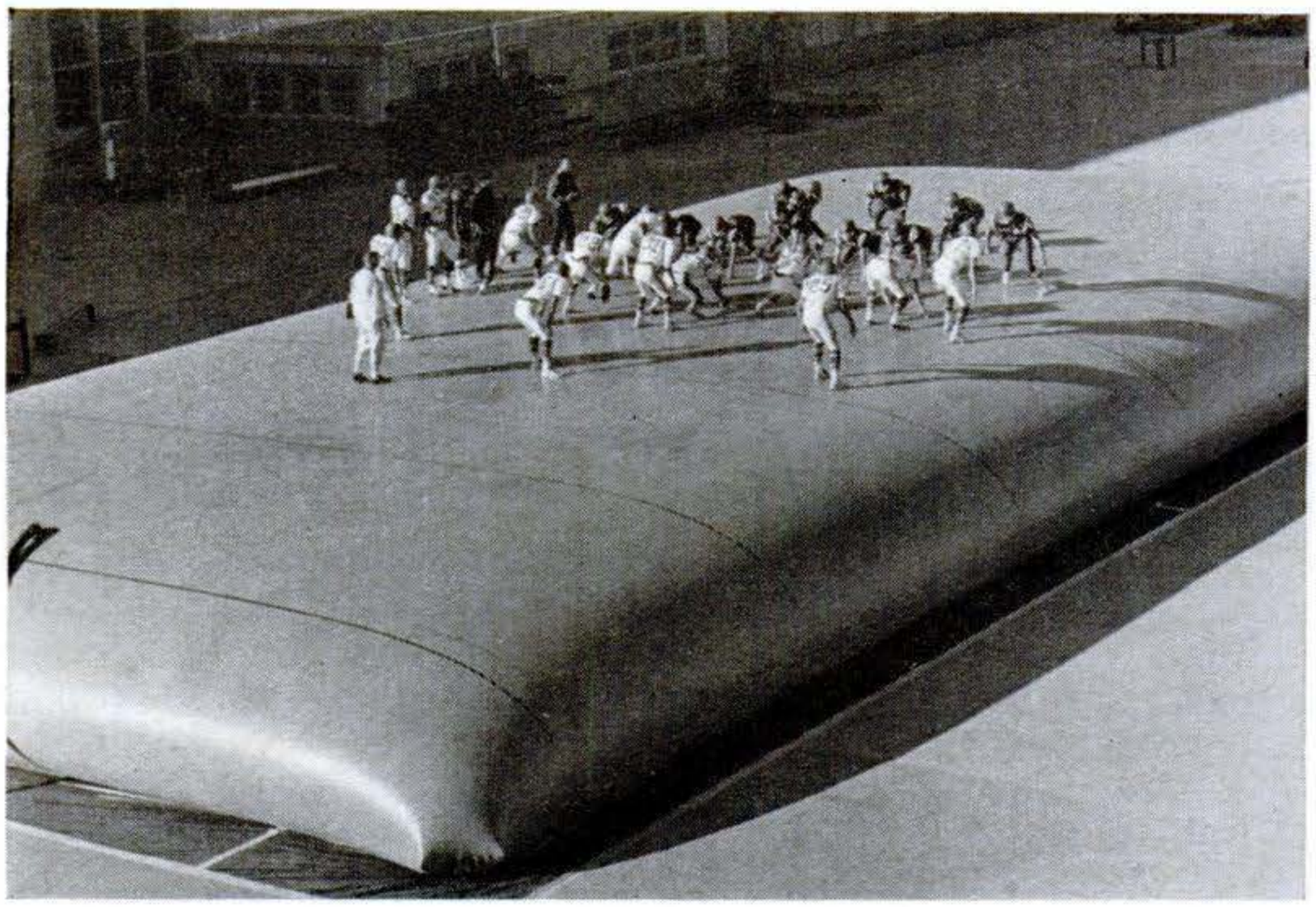


Step three: Screw in cap, puncturing cartridge. Make-believe keg around can is just for atmosphere.

Now you can have genuine draft beer at home—head and all

Take one gallon of draft beer—now available in many parts of the country—add a patented Draft Beer Tap and a CO_2 cartridge, and *presto!* You've got the same thing at home that's served at the corner tavern. The practiced beer drinker may take a sniff. Pure draft? Yup.

Here's how: The new gallon cans, unlike



Football on an Army "pillow tank"

When Goodyear began scratching its head for a way to demonstrate the size of a new "pillow" fuel tank built for the Army, it came up with the idea of posing a Phoenix, Ariz., high-school football team atop it. The collapsible container is 100 feet long, 48 wide. It's a seven-foot drop to the ground. The ends were in tight and the flankers absent.

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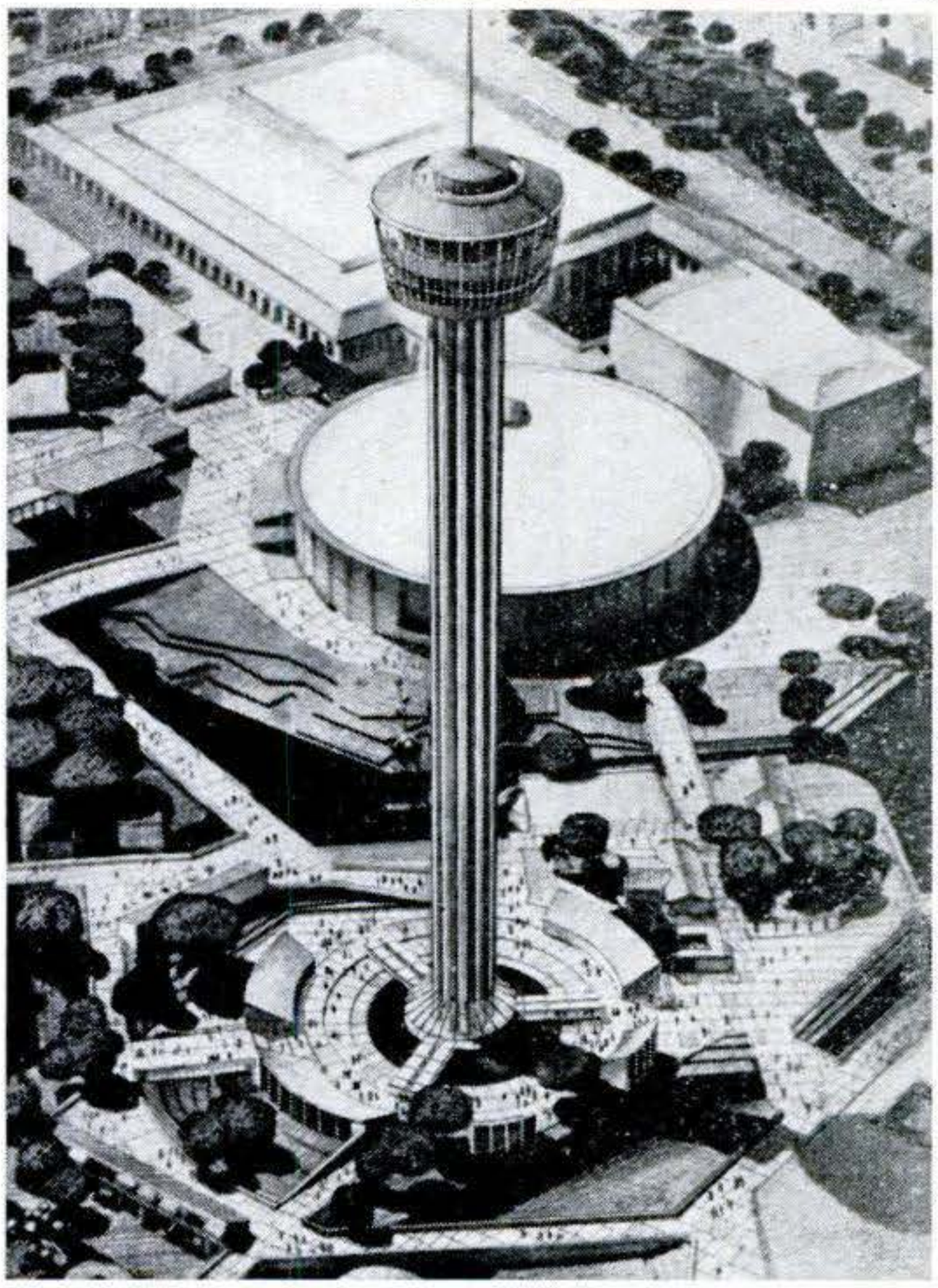
Step four: Press button on other end of tap, and *fizz!* New cans are inch shorter than quart bottle.

those found on grocers' shelves, are unpasteurized and come chilled to keep yeast dormant. Attach the Beer Tap. Put it in the refrigerator. When serving time comes, the cartridge provides the pressure. The device is made by Bridgeport Brass Co.

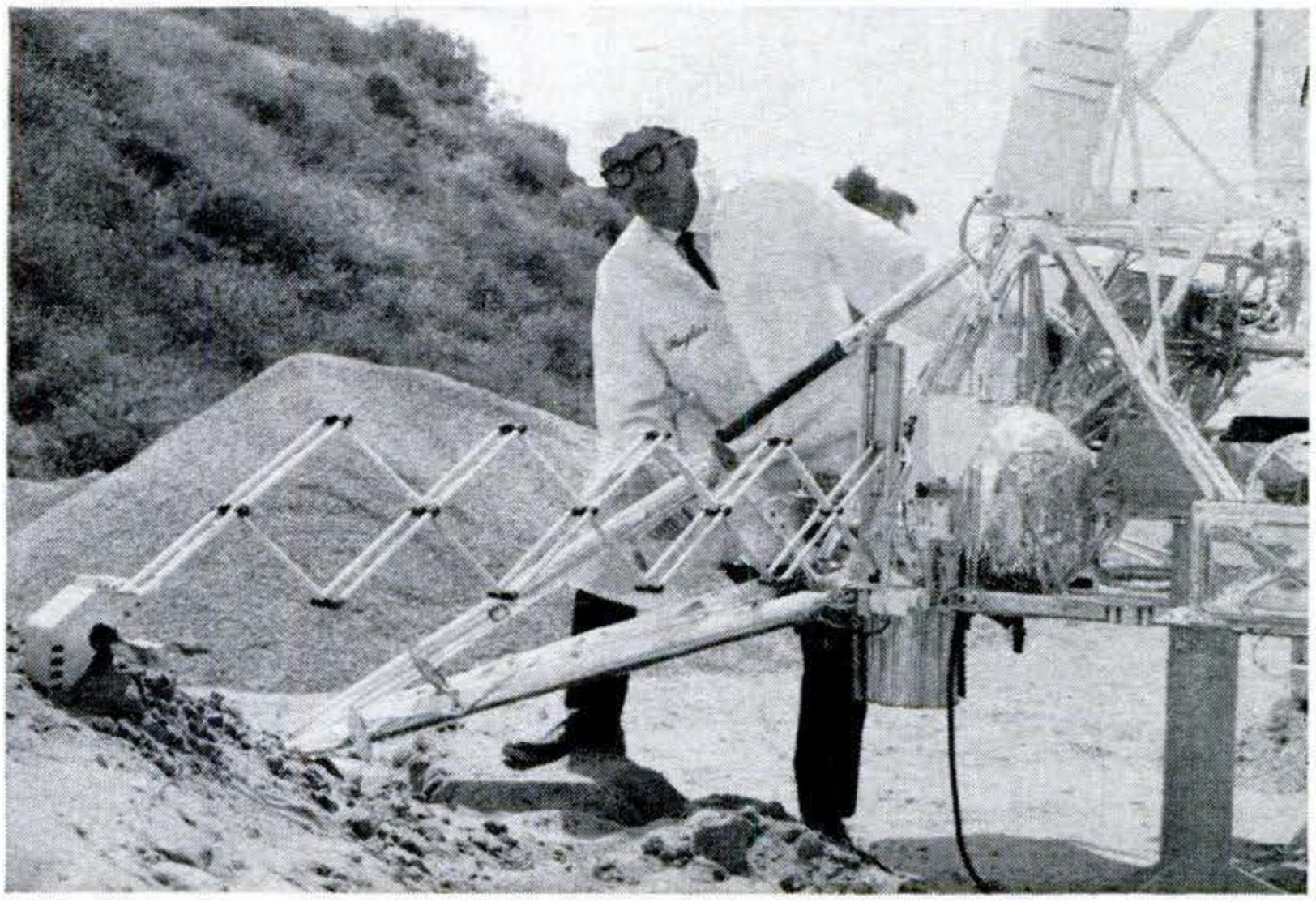


Texas fair to have ride with a view

When San Antonio's HemisFair opens this spring, visitors will be able to take a 43-second ride to the top of a 622-foot Tower of the Americas in three glass-fronted elevators installed on the outside. Each car will carry 27 persons. The international exposition's 62-story-high tower will have observation, club, and restaurant levels.

There are magnetic bits on the moon

Now NASA scientists know—the topsoil on the moon contains magnetic particles. An arm-and-claw "spoon" built by Hughes Aircraft for a Surveyor spacecraft landed on the moon and proceeded to rake some surface debris onto a magnet under the eye of a TV camera. It stuck. Here an engineering model of the spoon is under test.



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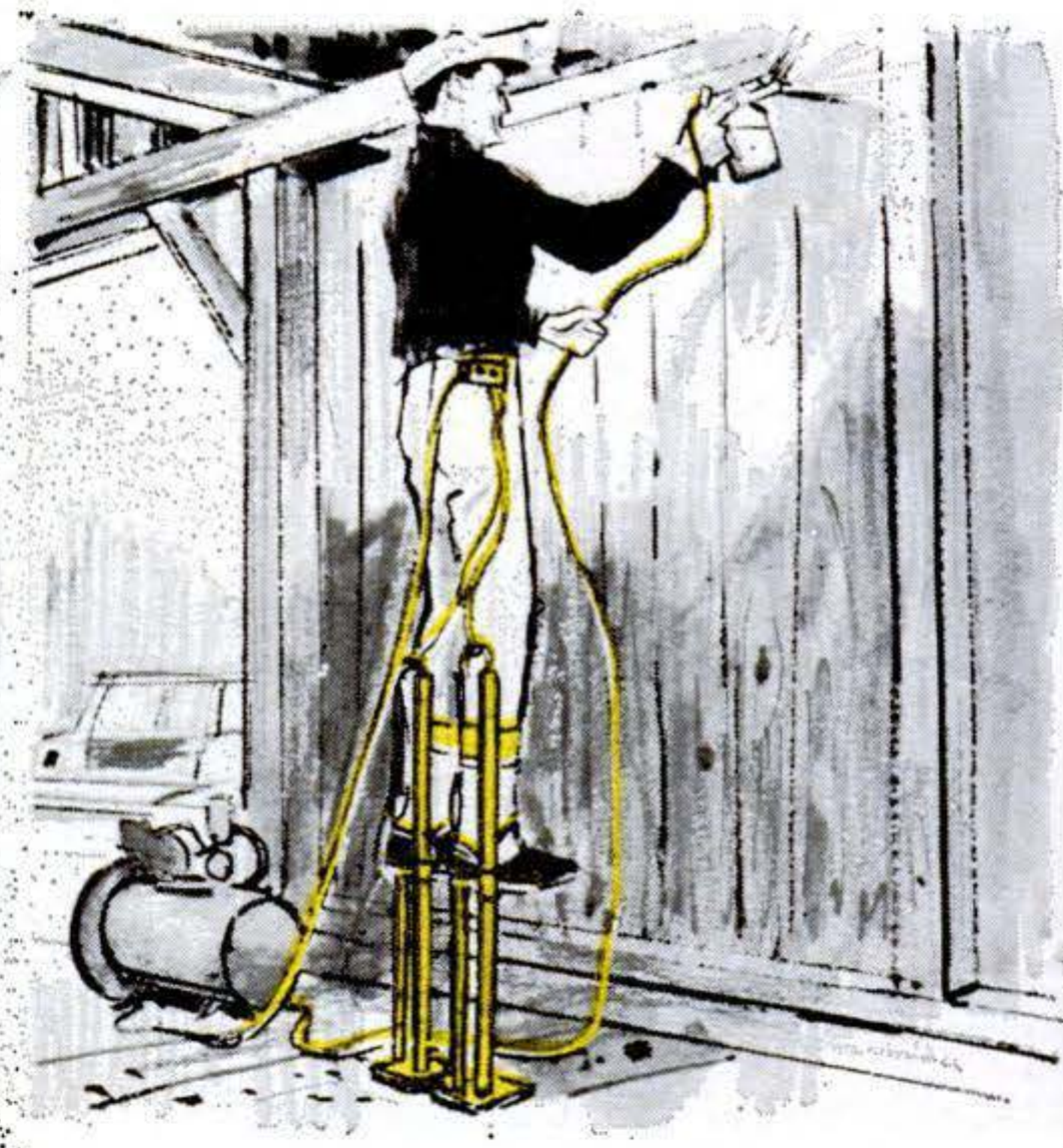
New Ideas from the Inventors

DRAWINGS BY WILLIAM CASTIMOR

Lift loads pickup truck. Heavy or bulky objects could be hoisted aboard more easily if light trucks were fitted with this recently patented loader. The frame would normally lie flat on the sides of the truck body, but could be cranked (hydraulically or by hand) to overhang the tail and serve as the mast of a load-lifting winch. With the load lifted high, the mast would be cranked inward to deposit the load on the truck's bed.

Planter holds escape ladder. A ladder folded into a compartment in the bottom of this window box would permit quick escape from a window in case of fire or other emergency. One end of the ladder would be secured to brackets bolted to the building, the other end to the inside of the planter box. Freeing the box from a simple catch and throwing it out would extend and weight the ladder.



Stilts lift you to do the job. Attached to the same air compressor you might use to operate a paint sprayer or power tools, these strap-on stilts would let you move up and down as well as horizontally. Valve-control buttons worn on the belt would let you extend or retract the stilts. Foot-supporting plates would be pivoted so you could move your ankles for better "walking" balance.

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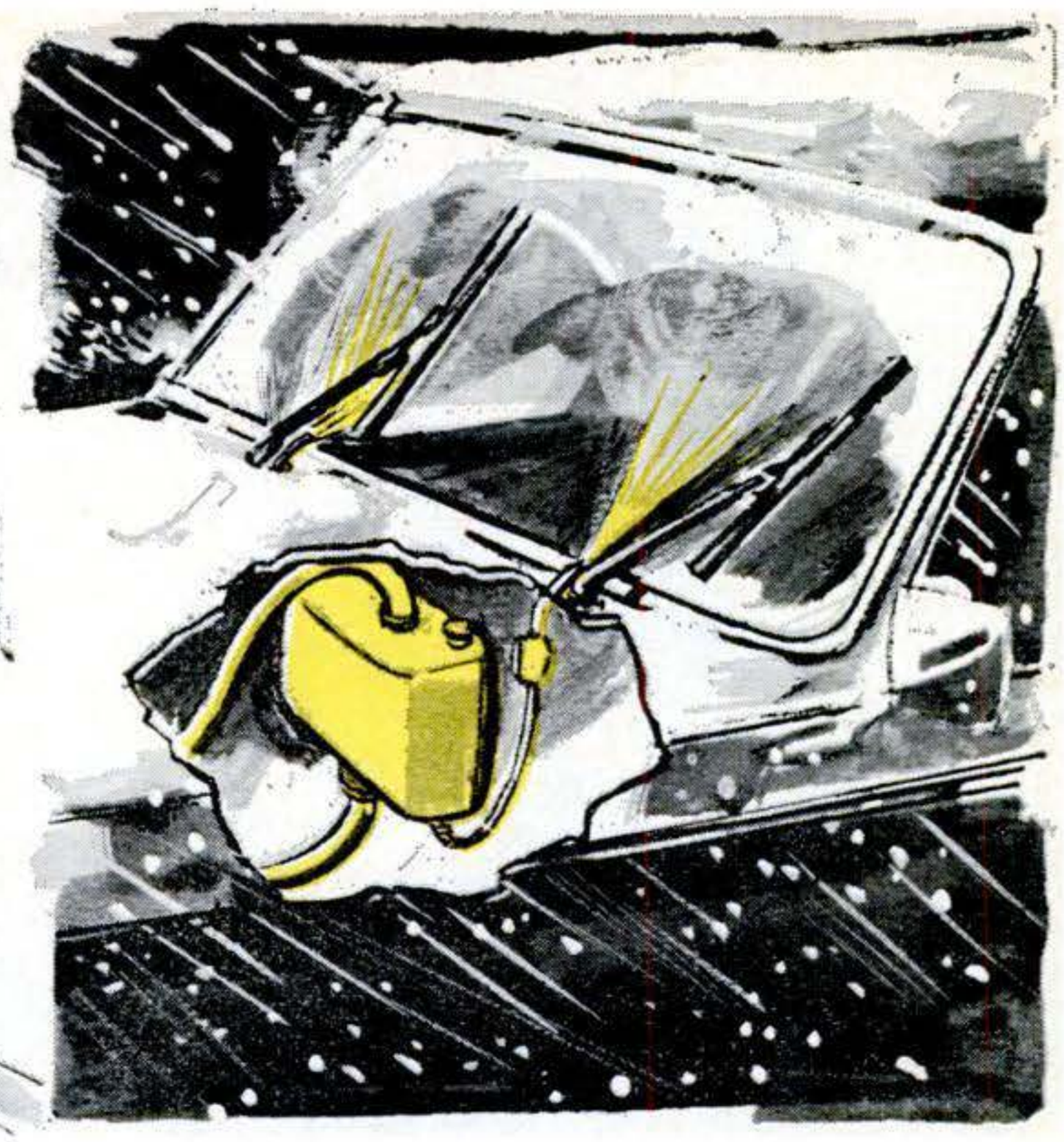
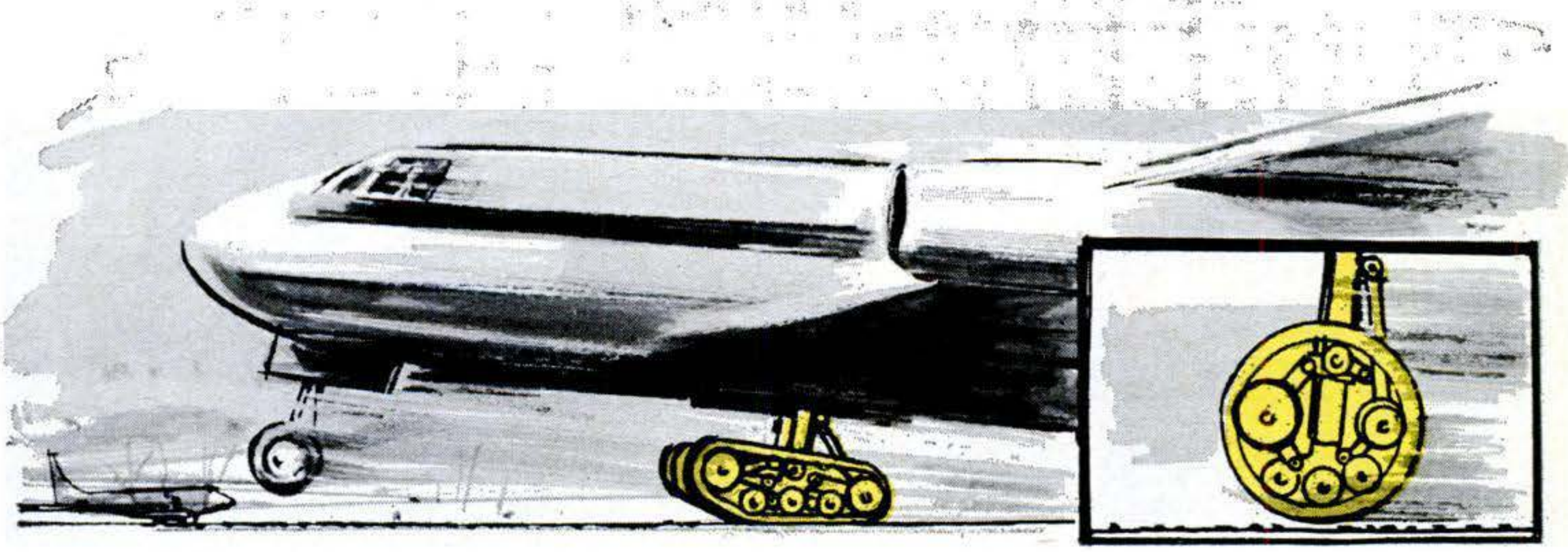
Ladder arms bridge gutter. Bracketed and clamped near the end of a ladder, this bridging attachment would let you work close to a roof edge without putting damaging weight against a gutter or roof overhang. And with the pivoted, nonskid pads pressed flat and tight against the roof surface, the attachment would also stabilize the ladder.



Warmed water washes windshield. A windshield spray warmed by engine heat could clear off snow or ice long before a defroster could pump up enough heat to do the job. Engine coolant running through tubes in this washer reservoir would heat the water. It would not only speed cleaning but would be more effective on slush from the road.



Plane wheels flatten under load. The elastic, endless track of this landing gear would adjust its shape—and therefore its ground-contacting surface—to spread a plane's impact over a wider area, improve braking, and lighten the load on a runway or apron. Unloaded, the tractors would re-form into wheels (inset) that could be retracted in flight.

The following patents have been issued on these inventions: **Pickup loader**—*No. 3,276,610 to C. R. Thatcher, Farmington, N. Mex.;* **Window ladder**—*No. 3,344,886 to J. Boscarino Jr., NYC;* **Strap-on stilts**—*No. 3,278,946 to C. R. Godwin, Indianola, Iowa;* **Ladder bridge**—*No. 3,288,249 to C. W. Gibson, Harrisburg, N.C.;* **Wash-water warmer**—*No. 3,292,866 to D. E. Benner, State College, Pa.;* **Variable landing wheels**—*No. 3,284,031 to F. C. Albright, South Bend, Ind.*

Copies of patents may be ordered, by number, from the Commissioner of Patents, Washington, D.C. 20231, at 50 cents each. To write to an inventor, if the address above is insufficient, address him (by name and patent number) in care of the Commissioner of Patents.

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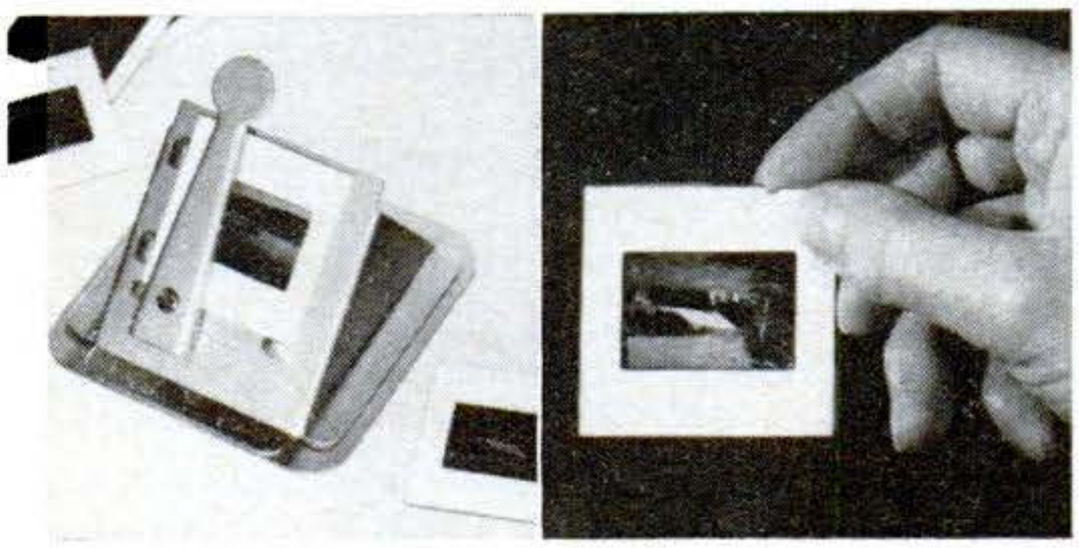
Ultramini Minox gets an ultramini strobe

A tiny two-ounce reflector head, shown at left, is made to slide onto a Minox B camera. It holds the flash tube and ready light of the Minox-Heliotron. The power pack slides into your pocket. The unit gives 160 flashes on a nickel-cadmium battery charge. Minox Corp. Price: $74.95.

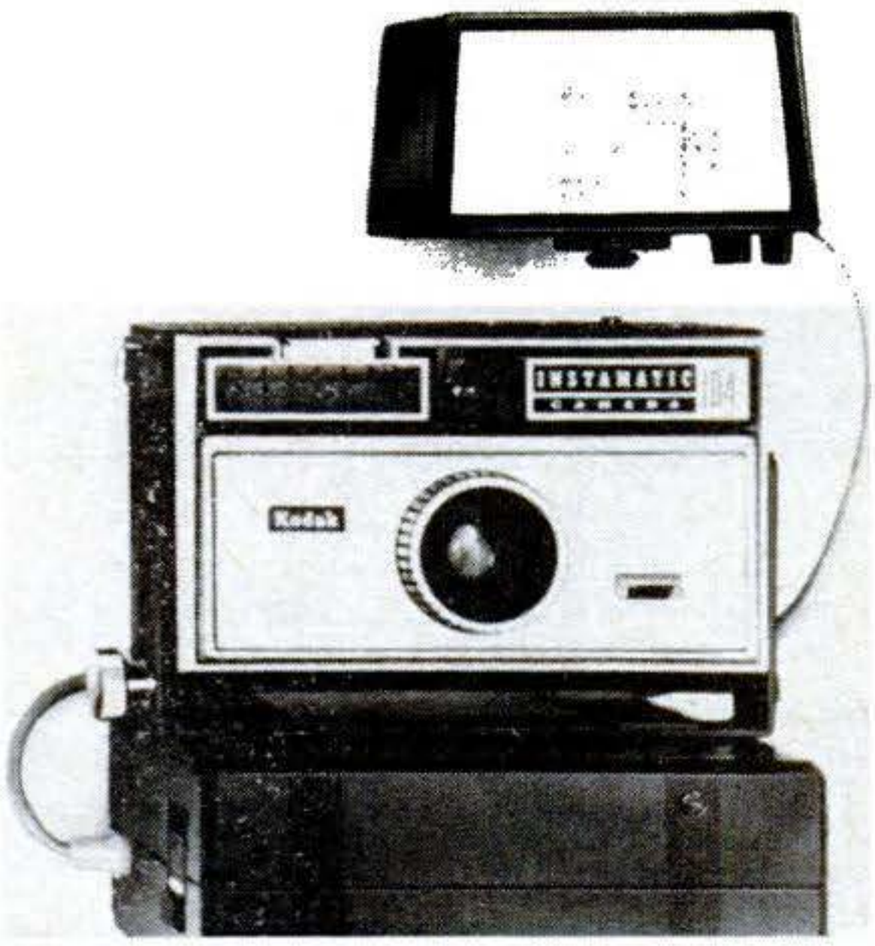


Slide notcher for foolproof slide shows

You'll never project a slide upside down or reversed if you notch your slides with this Slide Guide. It's $8.95. Keystone Corp., 1095 Nigara St., Buffalo, N.Y. 14213.

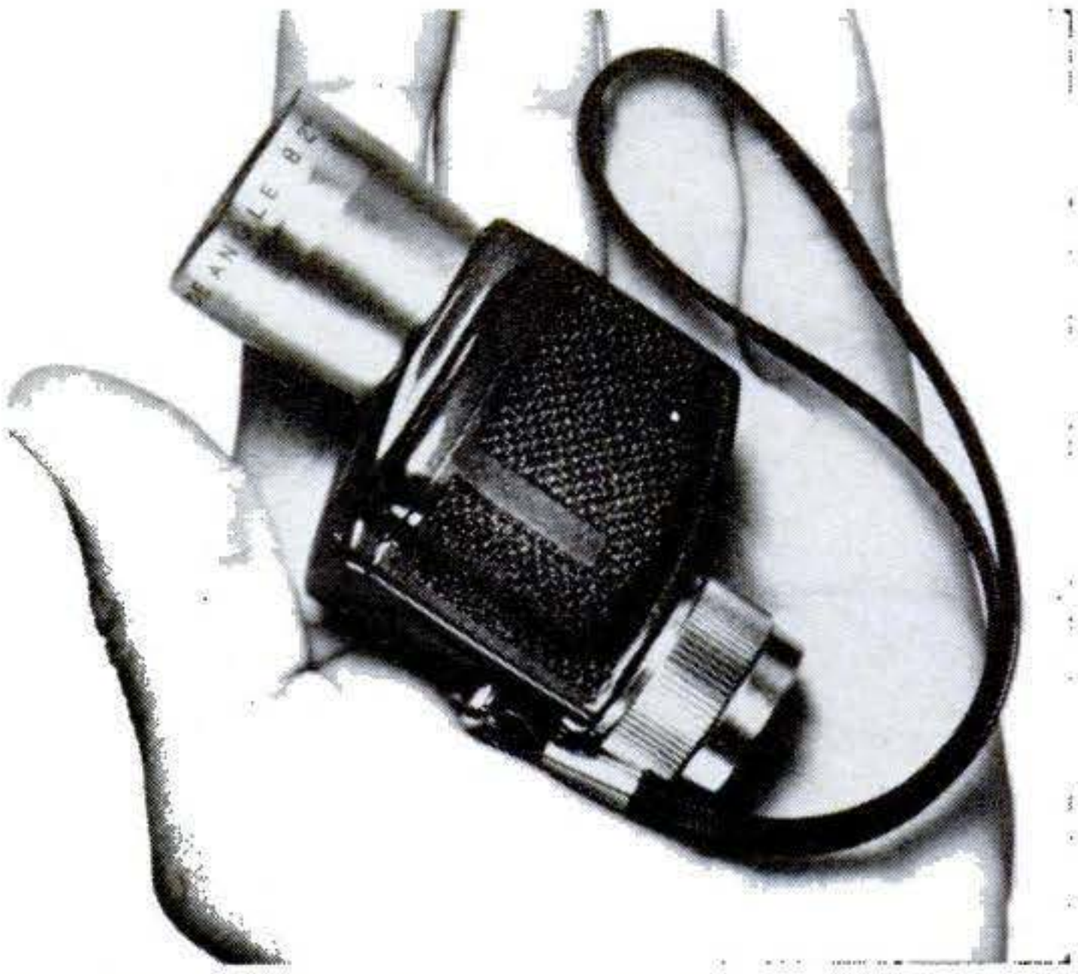
Strut for distortion-free enlargements

This adjustable scissoring device raises your enlarging easel to correct for distortion. It's $3.95 from Spiratone, 135-06 Northern Blvd., Flushing, N.Y. 11354.



Strobe unit for flash-cube-type cameras

A strobe unit for flash-cube-type cameras? That's right. Perma-Cube comes with rechargeable batteries (good for 30 shots), $24.95, or with AA cells, $19.95.



New telescope fits in your palm

Bushnell's new Palm-Pocket telescope fits in your palm, offers eight-power magnification. For close-ups, front lenses change to give six power. With case, $19.95.

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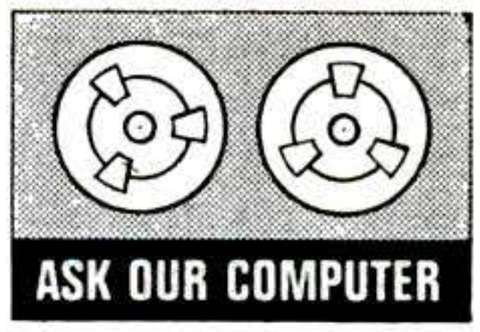
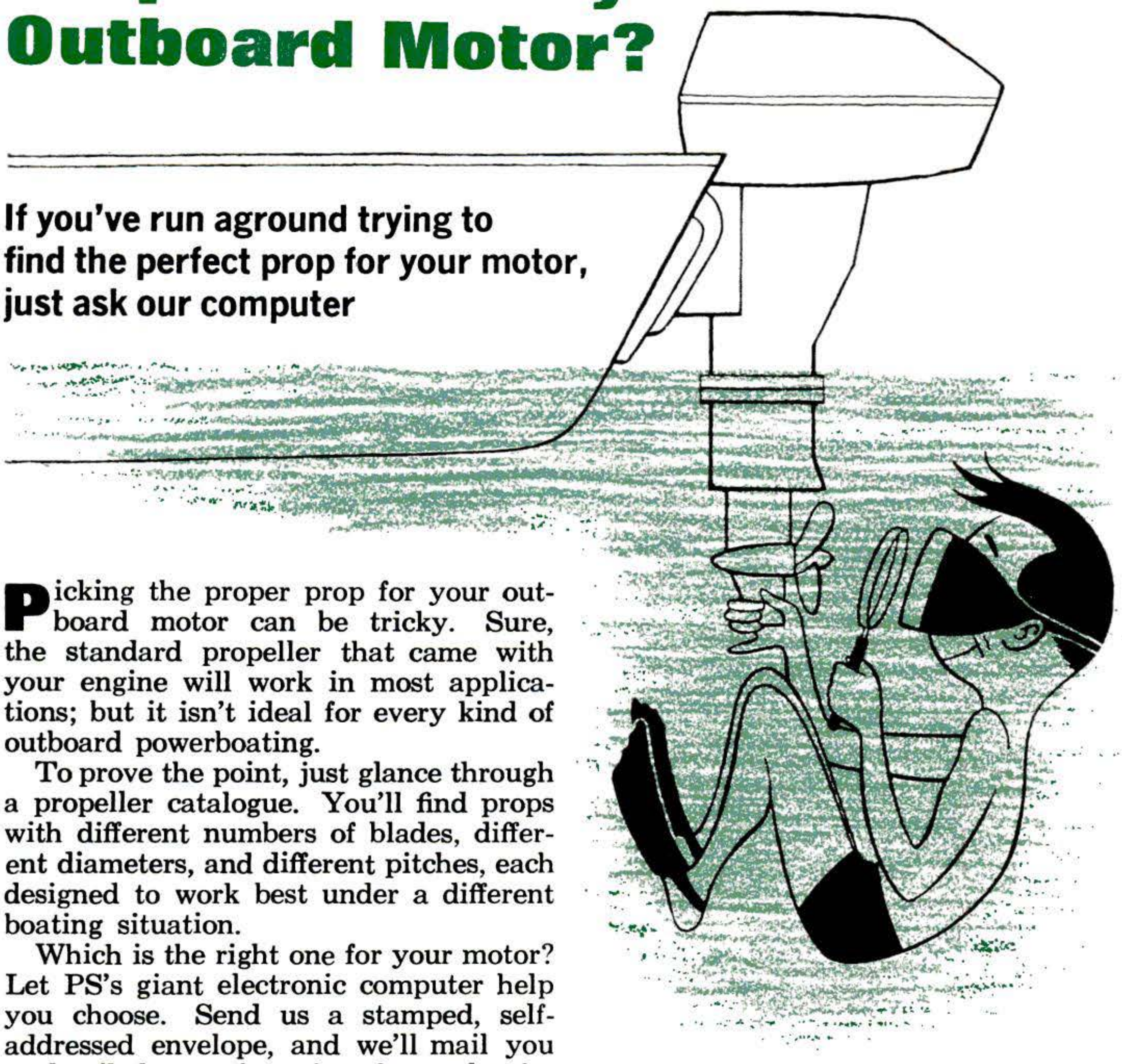
This month's question for the Ask-Our-Computer service

Which Is the Right Propeller for My Outboard Motor?





If you've run aground trying to find the perfect prop for your motor, just ask our computer

Picking the proper prop for your outboard motor can be tricky. Sure, the standard propeller that came with your engine will work in most applications; but it isn't ideal for every kind of outboard powerboating.

To prove the point, just glance through a propeller catalogue. You'll find props with different numbers of blades, different diameters, and different pitches, each designed to work best under a different boating situation.

Which is the right one for your motor? Let PS's giant electronic computer help you choose. Send us a stamped, self-addressed envelope, and we'll mail you a detailed questionnaire that asks for specific information about your outboard motor, your boat, and the kind of boating you do.

When you return the completed questionnaire to us, along with a $1 service fee, our computer operators will feed your data into the machine.

We've written a new computer program called PROP that will convert the bits and pieces of information into propeller requirements. It will then compare these requirements with the specifications of a large assortment of currently available propellers, and prints out a list telling you which model (or models) comes closest to meeting your needs. You will receive the actual list produced by the computer.

Send your stamped, self-addressed envelope (legal size) to Ask-Our-Computer, Program #8, POPULAR SCIENCE, 355 Lexington Avenue, NYC 10017.

If you have any suggestions for problems that would make suitable Ask-Our-Computer programs, write them on a postcard, and mail to Ronald M. Benrey, Electronics Editor.

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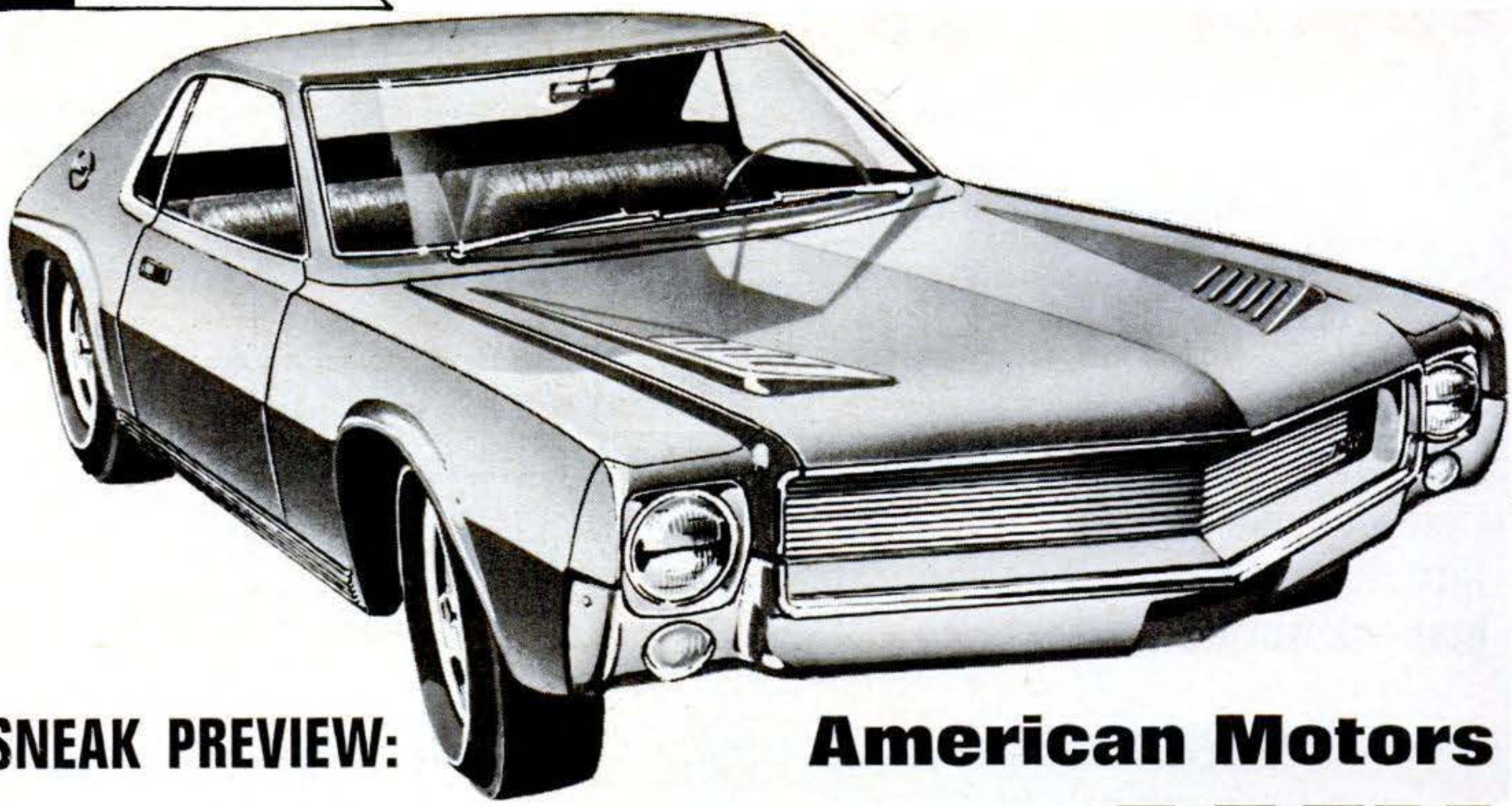
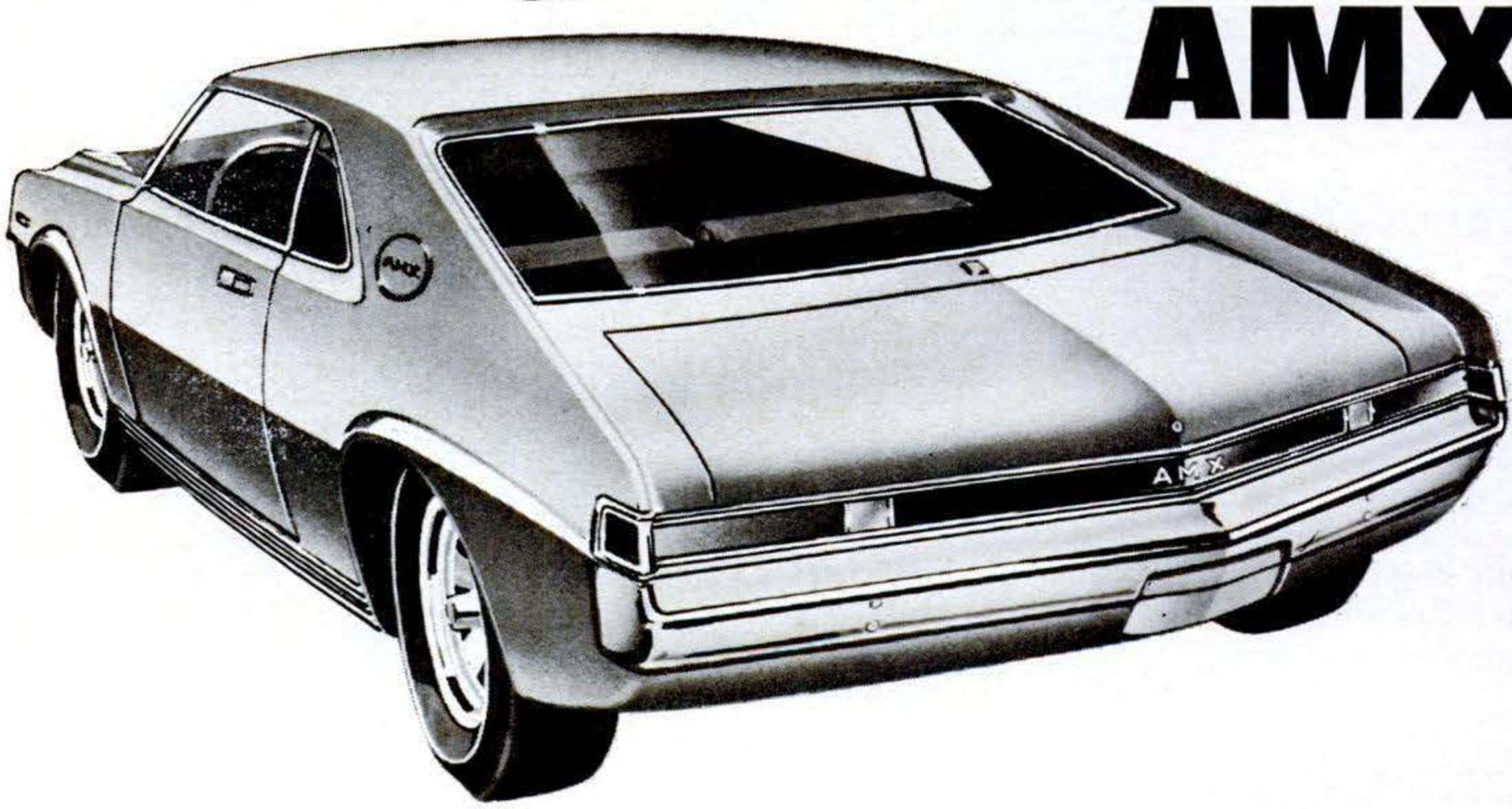


SNEAK PREVIEW: American Motors AMX



American Motors' one-two product punch, which began with the Javelin, will culminate late this month with the unveiling of the AMX. An all-out performance car with a brand-new 315-hp., 390-cu.-in. engine, it's designed to be the prestige car of the American Motors line and—hopefully—the No. 1 sports car in the U.S. It's the first serious challenge to the Corvette since the '55-'57 T-bird.

Among American cars, AMX is closest to Corvette in body dimensions and wheelbase. In suspension and body design, however, the two cars differ radically. AMX is an all-steel, unit-body car with conventional coil springs in front, a rigid-axle, leaf-spring setup in the rear. Heavy-duty components give the stiff, flat ride sports-car drivers demand.

Styling follows the theme of the Javelin, and there's much interchangeability in parts between the two: engines, transmissions, rear axles, body structure, instrument panel, seats, bumpers, front fenders.

Base power is the company's 290-cu.-in., 225-hp. V-8. Other options: a 327-cu.-in., 280-hp. V-8 and a new 390-cu.-in., 315-hp. V-8 (said to give 0-60 acceleration of 6.6 seconds). You can't get a six.

The car is designed to carry two passengers in bucket seats. The trunk is small, separate, and lockable. Price for the base car: probably slightly over $3,000.

Other specifications: wheelbase, 97 inches; length, 177; height, 51.7; weight, 3,100 pounds.—*Jim Dunne.*

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How to Build a Shaker Settee

Making this handsome cherry bench—an authentic copy—will keep your lathe busily spinning for a weekend

By DAVID WARREN

The only place the early Shakers liked embellishment was in their religion. Their name comes from an ecstatic dance performed as part of their worship. In contrast, their everyday community life was based on the no-nonsense principles of celibacy and self-sufficiency.

These attitudes are re-

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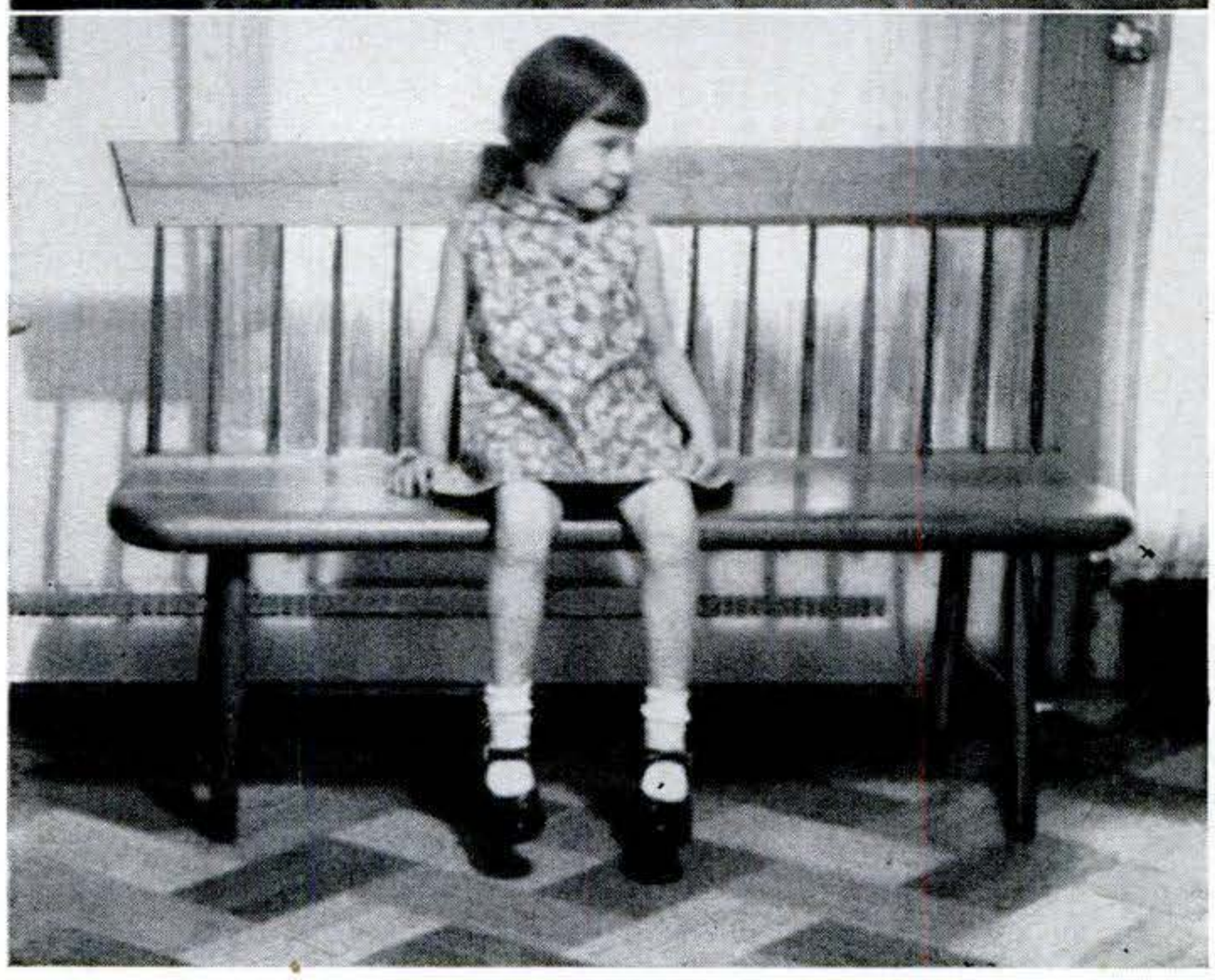

Bench is right at home whether indoors or out. Use waterproof glue and exterior varnish on a bench that will be exposed to weather.

Turn the page for lie-flat blueprint

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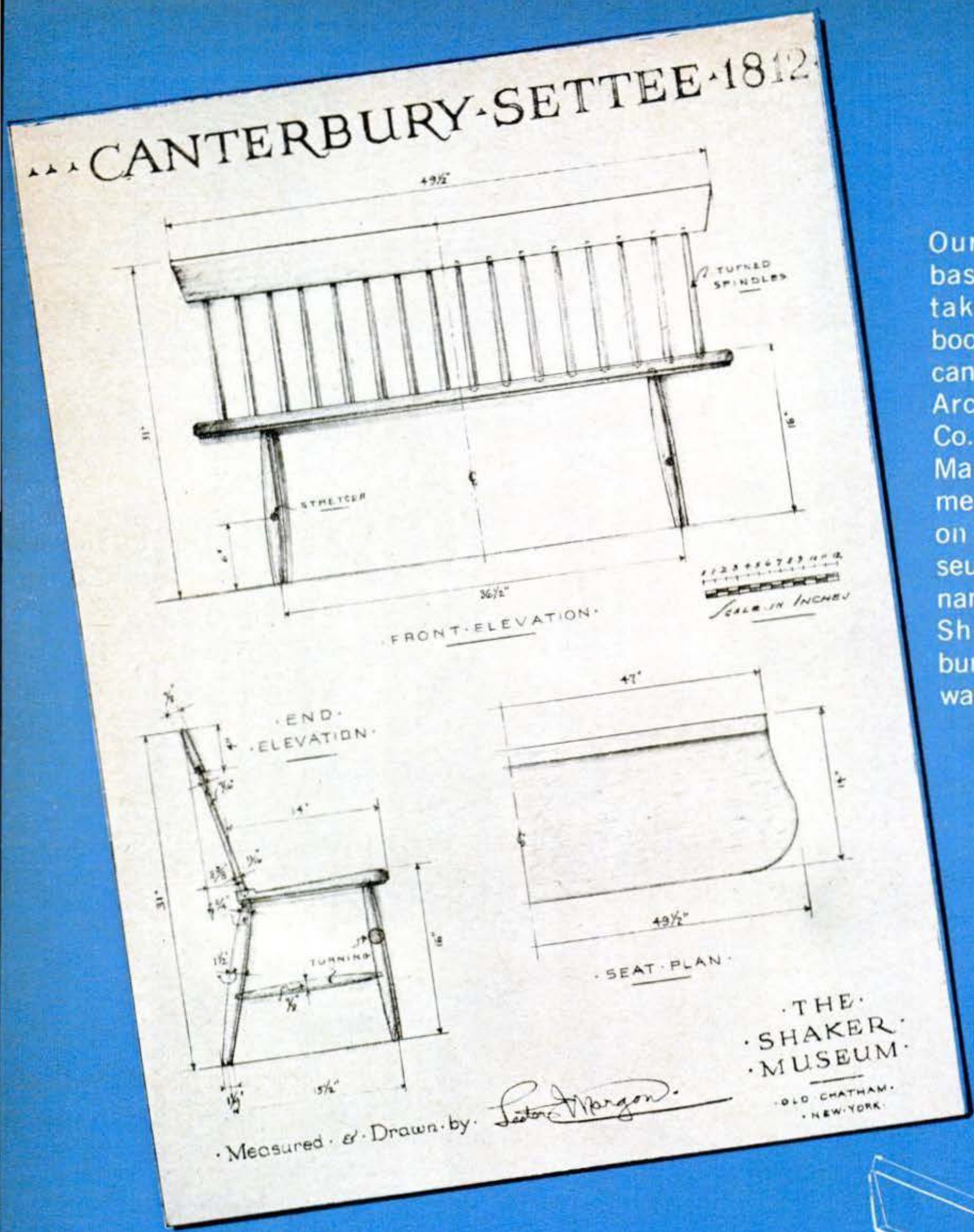


Our blueprint this month is based on the drawing at left, taken from Lester Margon's book, "Masterpieces of American Furniture" (copyright 1965 Architectural Book Publishing Co., 151 E. 50 St., NYC; $12.50). Margon made the drawing after measuring the Canterbury settee on exhibit at the Shaker Museum, Old Chatham, N.Y. The name refers to the still-active Shaker community—Canterbury, N. H.—where the bench was made around 1812.

The Editors

MATERIALS LIST

CHERRY WOOD

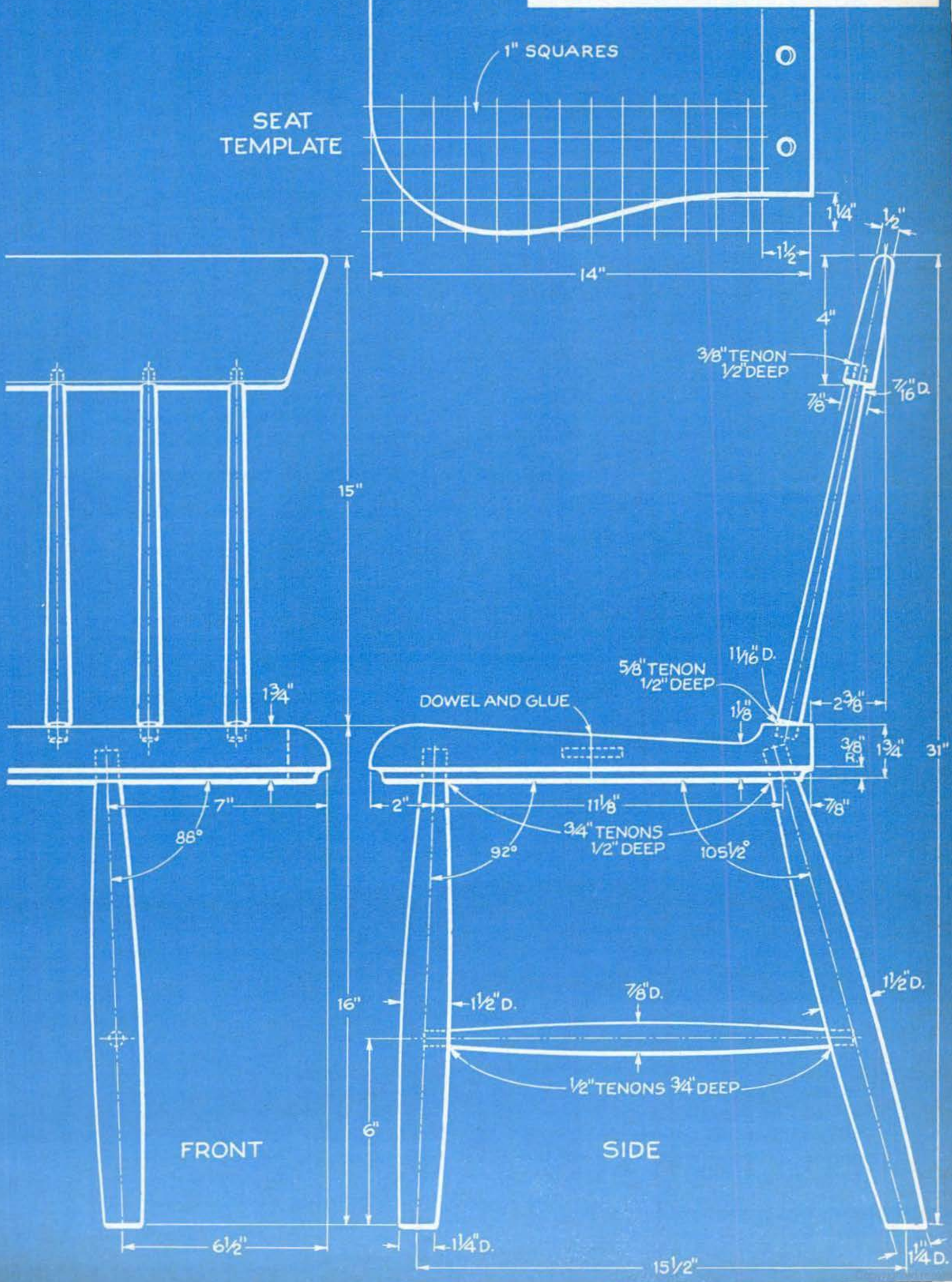
2 pcs. 2" x 8" x 51", seat
4 pcs. 2" x 2" x 18", legs
2 pcs. 1" x 1" x 18", stretchers
16 pcs. 1" x 1" x 14", spindles
1 pc. 1" x 1" x 51", backboard

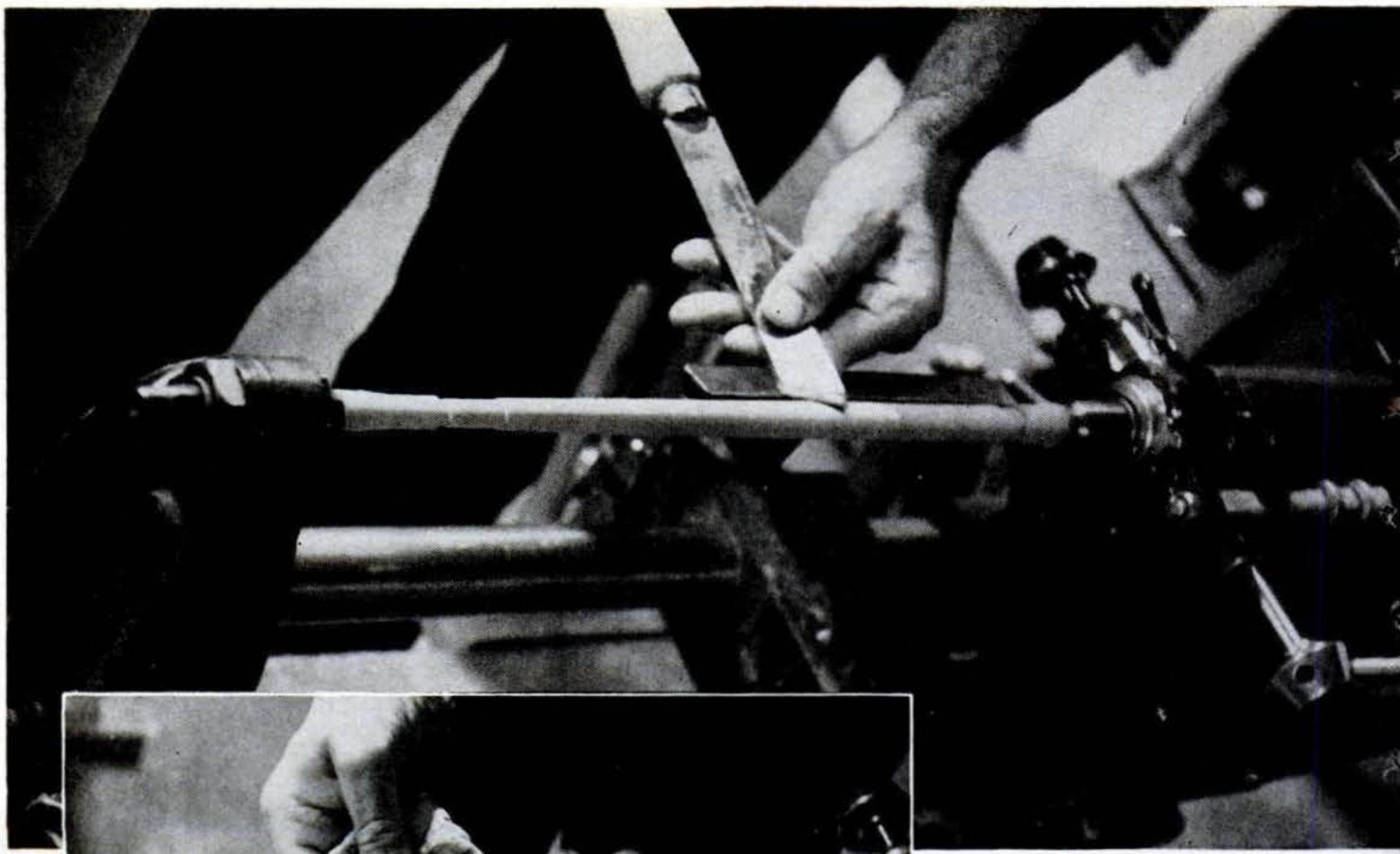
MISC.

4 chair glides, glue, shellac

PS LIE-FLAT BLUEPRINT

1812 SHAKER SETTEE





Easiest way to turn legs and spindles is by taking measurements from a full-scale end-view drawing. Each leg takes a half-hour to turn—spindles 20 minutes. Shellac padded on (left) builds to a smooth sheen quickly. Lubricate the pad with linseed oil and avoid getting shellac on the tenons.

flected in the furniture they produced for their settlements—especially those along the New York-Massachusetts border, several of which are now museums. The original of this bench is on display in one of them, though its name comes from Canterbury, N. H., where it was found.

It's typical of Shaker design—strictly utilitarian, without frills or unnecessary parts. Of all period furniture, Shaker pieces make the most direct appeal to modern tastes. This bench will be at home in any room style.

You'll note it lacks lateral stretchers to strengthen legs or back. It is reasonable, therefore, to question the bench's sturdiness. But I built two for use in the family recreation room and our six shaking youngsters haven't been able to loosen a joint. The reason: quality-designed, deep-set hardwood joints.

Where to start. Edge-glue and dowel the seat boards to the required width. When the glue has dried, you can start the scooping operation. An electric power plane or router are laborsavers here, but a scrub or jack plane will do the job, too—it just takes a little more energy and patience. After scooping, make a cardboard template for marking the curved seat ends. Cut with a saber saw and finish shaping with a spokeshave. Carve the cove detail in the lower edge with a router and cove cutter, or use a ¾" No. 6 gouge.

Don't drill the leg holes in the seat underside until you have turned the legs. Then, if the tenons are overcut, you can compensate with a smaller drill bit to assure a snug fit.

The lathework. The best way to turn the spindles and legs is by taking dimensions from a full-scale end-view drawing. Size the tenons by setting the calipers to the drill bit you will use for the

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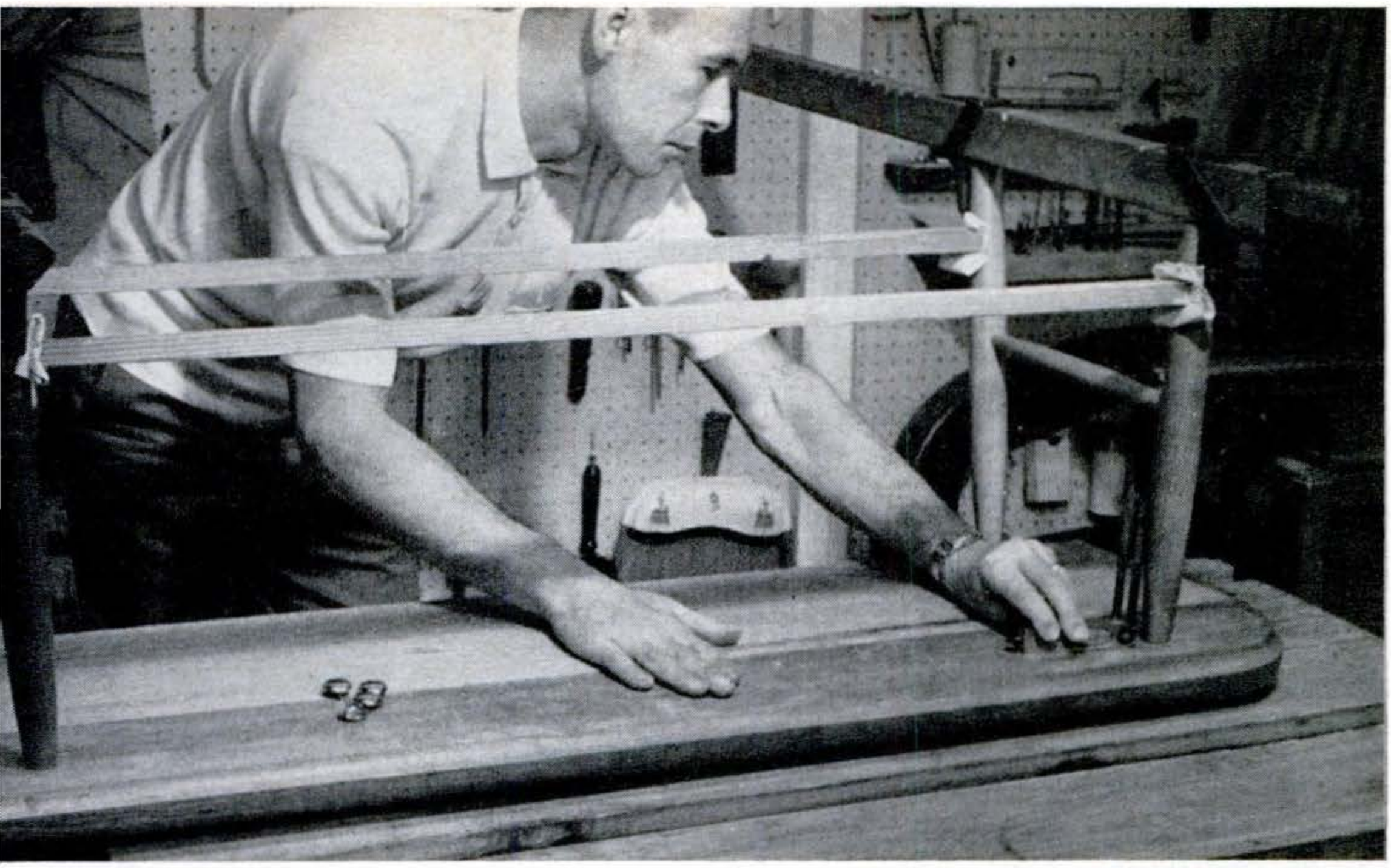
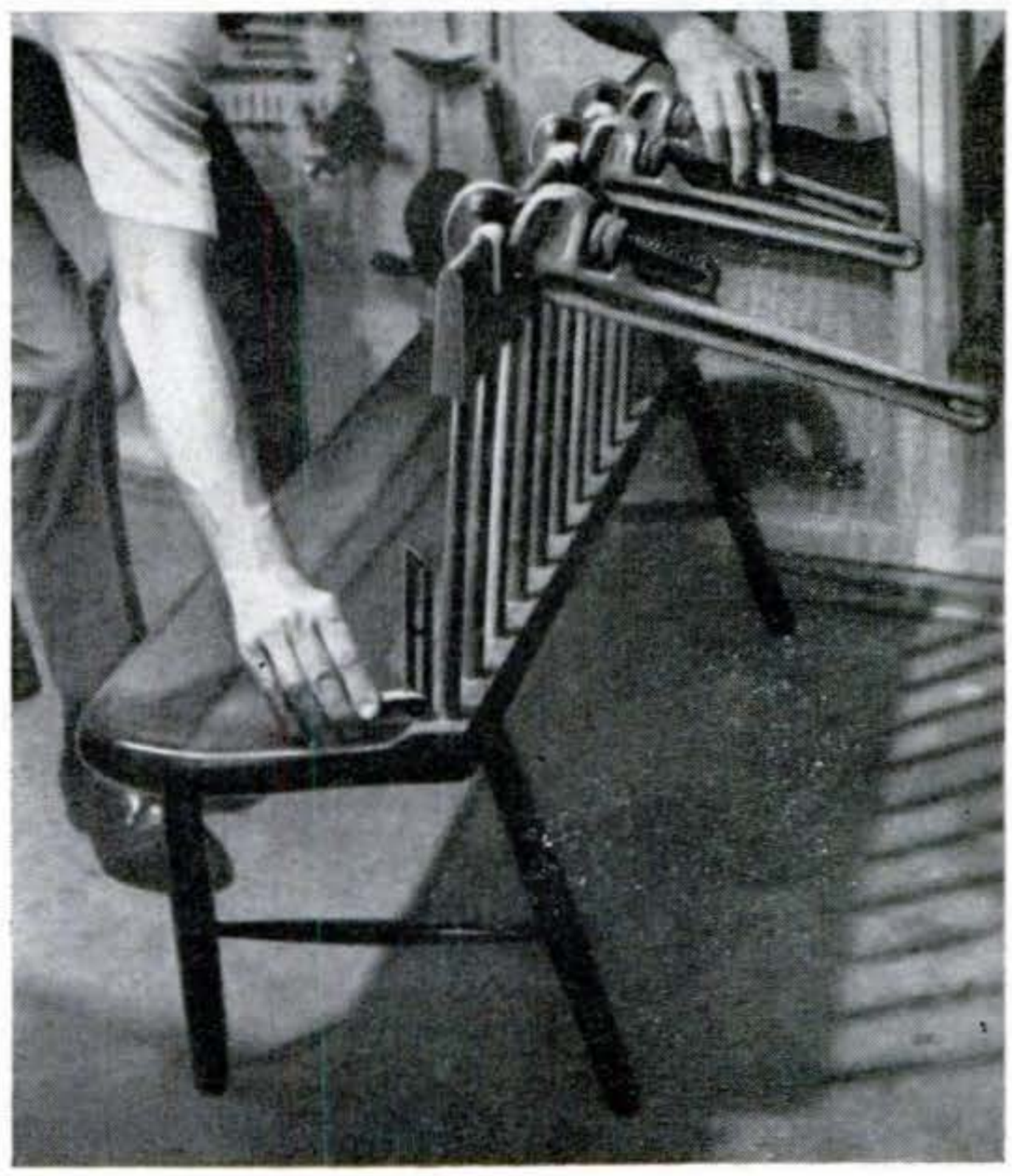


Temporary stretchers, 35″ long, are wedged between legs to hold the leg cant while the glue dries. Back is held at uniform angle (right) by weighting. As each wrench is added, check with bevel square.



mating holes. Make the straight portion of the leg tenon ⅛″ shorter than the depth of the seat hole; this leaves room in the hole for setting the leg flare.

Drill the stretcher holes in the legs last. Caution: Once two legs and a stretcher are joined and driven into the seat, they are locked in. Removal without breaking the stretcher would be difficult. To be safe, test for fit before final assembly.

Assembling the back. Taper and sand the backboard and cut the waste off both ends. To lay out the spindle holes set your dividers at about $2\frac{5}{16}$″ and tick off 16 points on the bottom edge. Adjust the dividers until the distance from the first point to the 16th is precisely 44″. Next make a mark 1½″ in from the first end. Walk off the remaining 15 points—the 16th should be exactly 1½″ from the other end.

Line the backboard up with the seat and transfer the marks with a try square. Drill the spindle holes and set the angle of the back on the bevel square. From here on you have to move at a steady clip. Glue and assemble the entire back, weighting it as shown in the photo.

I finished my bench by padding shellac on while the pieces were spinning. It's a fast way of building a high, lustrous polish. Use a lintfree cloth for the pad and keep it lubricated with a few drops of linseed oil. But keep shellac off the tenons; it seals the wood, reducing the strength of the glue joints. If you're building the bench for patio use, protect the wood with several coats of exterior varnish. Chair glides (⅞″) on the legs compensate for any slight wobble. PS

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Let's Look at the

More electric starters are one addition you'll find this year—even on some hand-push mowers

By E. F. LINDSLEY
PS Outdoor Power Equipment Editor

What new feature would you most like in your next mower? A survey of '68 models indicates that quite a few improvements are waiting for you, if you haven't bought a new machine for several years.

First, there's automobile-type engine starting. Thrust a key into the ignition lock, turn it, and a 12-volt battery actuates an electric motor and Bendix drive to start the gas engine.

Two battery systems. A small wet-cell battery is the heart of electric-start models available from Outboard Marine's Lawn Boy Division. Tests indicate that the battery will give enough starts for the entire season. In the fall, bring it up to snuff again with a trickle charger.

Jacobsen, Toro, General Appliance, Huffy, and Southland are among companies that have introduced a starter powered by a nickel-cadmium battery pack, kept charged by hooking up a trickle charger between mowings.

Electric starters are available mostly on deluxe self-propelled walk-behind and riding mowers, but at least two push-type models have it. Electric-start models cost from $20 to $40 more.

Other things you might want have been around for a season or two. A look at this year's mowers shows:

- A lot of single-control cutting-height adjustments.
- Conveniences such as gas gauges, easy-fill oilers, better ways to clean grass out of the rotary housings.
- Greater attention to improved aerodynamic design of blade and housing for better cutting and mulching action.
- More thought given to discharge chutes and their safety characteristics.

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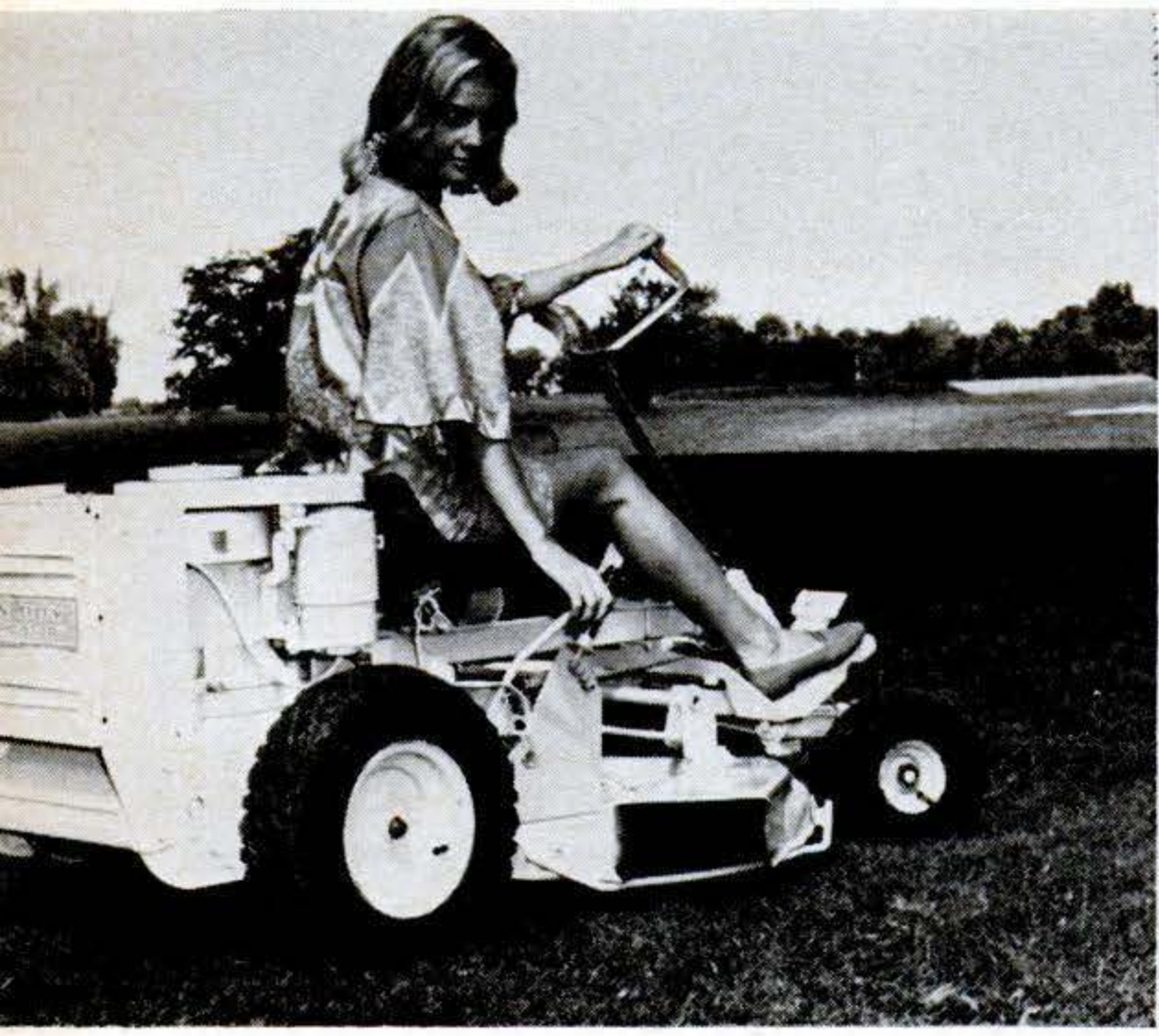

Lawn-Boy's new 30" rider has an electric starter, operated by a wet-cell battery that needs recharging only once a season. Gearshift lever located on the right gives three speeds forward plus reverse.

Latest in electric mowers are shown here—Black & Decker's new 22" dual-blade model above and Toro's 19" direct-drive Whirlwind on the facing page. The first is a larger version of 18" model introduced

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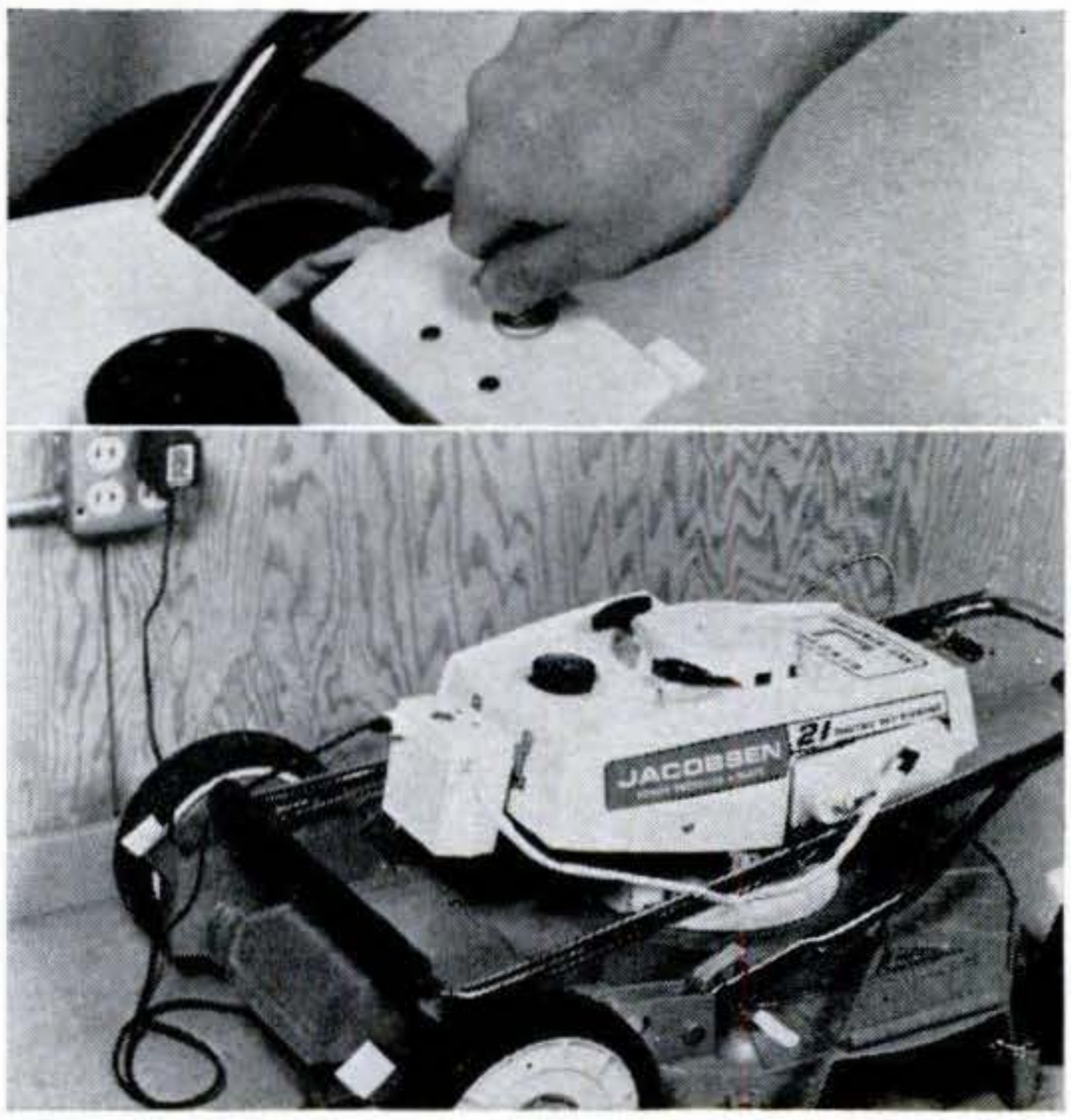
Power Mowers for '68

New look in reel mowers is presented by five-hp. Yardman. Spring-mounted wheels up ahead suspend the reel, which extends beyond mower wheels. Result: These don't depress uncut grass ahead.

A new rotary mower, this six-hp. Cadet 60 rider is International Harvester's latest addition to its line of home and farm machines. It has a 32" rear-throw mower deck that raises or lowers on the run.

a year ago. Other companies that now offer electrics include Sunbeam (which largely pioneered the type), Sears, Montgomery Ward, Thor, MTD, Atlas Tool, Pincor. Lawn-Boy may also enter market soon.



Electric starting with a key is new this year on quite a few mowers, including this Jacobsen. Turn the key and a 12-volt battery starts the gasoline motor. Remove the key, and ignition is locked off.

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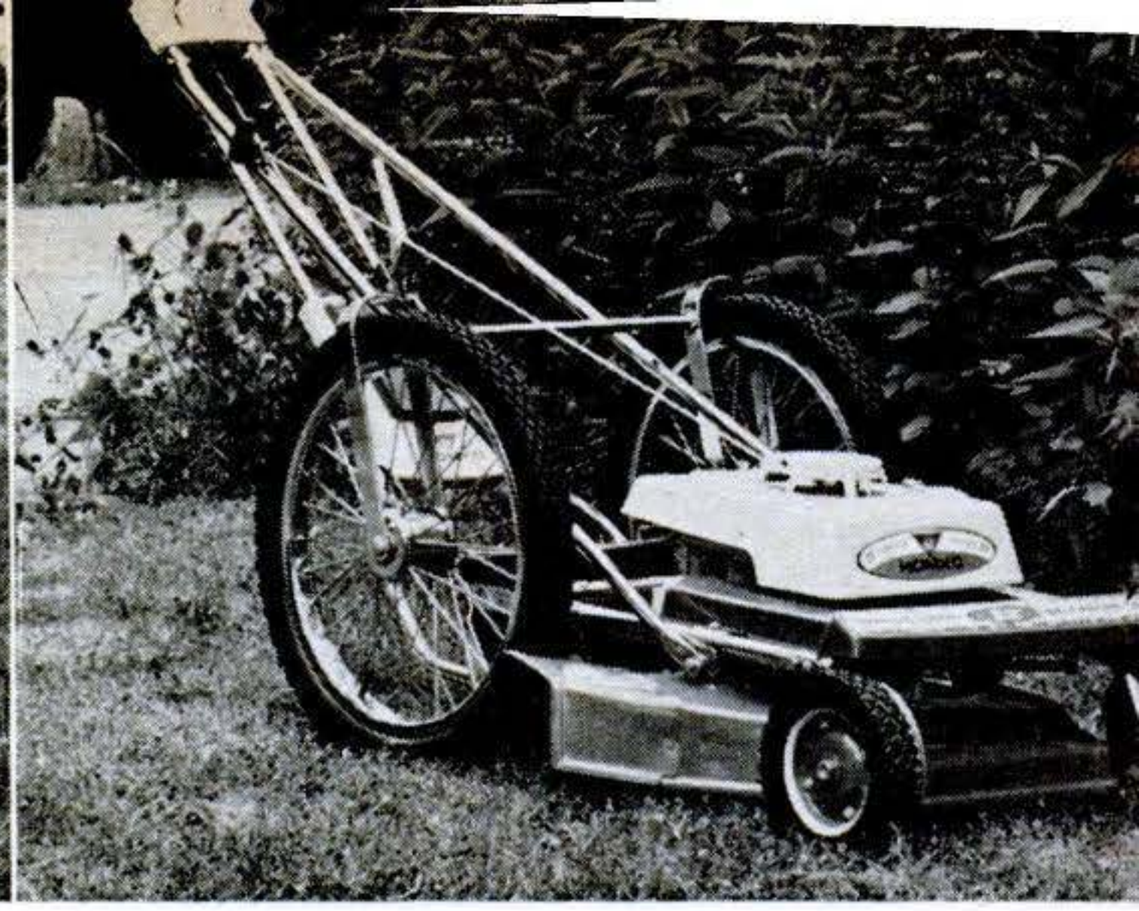
You can dump clippings as you mow with the grass catcher supplied for Bunton's eight-horse 32" Lawn Lark, with optional sulky. Installed without tools, the catcher is worked by a control on mower handle.



High wheelers are growing in popularity. This 22", 3½-hp. AMF/Homko is an example of what's available. It's self-propelled and has a high-tempered steel Flexor blade, with flexible tips to avoid shock.

Front-mounted engine is said to give the Homelite Yard-Trac stability on hills and sloping ground. The 26" riding mower has all controls within easy reach of the driver, including four-speed shift lever.

Front-throw reel, a 25-incher, is one of several rugged mowers from Starlite Mfg. Co., Harbor City, Calif. Wide tires give good weight distribution on lawns. Deluxe-model sulky is available for riding.

- Nearly all mowers with grass-cutting bags (at least as options). Many are improved in ease of attachment, emptying convenience, and durability.
- Differential drives on self-propelled mowers.
- Automatic ignition-timing retard and compression releases for easier starting.

Rotary or reel? Largely because of lower cost, many buyers think only of rotaries. But the old reels are still with us —many with new advantages.

One industry leader says the reel mower "leaves a better looking and greener lawn because it shears the grass blade instead of fracturing or tearing it. Reel mowers have approximately twice the life of a rotary mower."

The old reel rotating in line between the driving wheels has been about washed out by designers intent on improvement. The reel has been moved out ahead. It projects beyond the driving wheels on each side, leaving no strips of uncut grass crushed down by the wheels.

Jacobsen, Yardman, King 'O Lawn, and Starlite are among makers with front-throw reel models.

Ride or walk? More buyers go to riding mowers each year, but an industry report indicates that at least 84 percent of buyers stick to the walk-behinds. The latter divide into two groups:

- Hand-push rotaries with power applied only to a rotating blade.
- Walk-behind, self-propelled rotaries and reels with power applied to both cutter and drive wheels.

But no buyer should overlook the merits of the high-wheelers now growing

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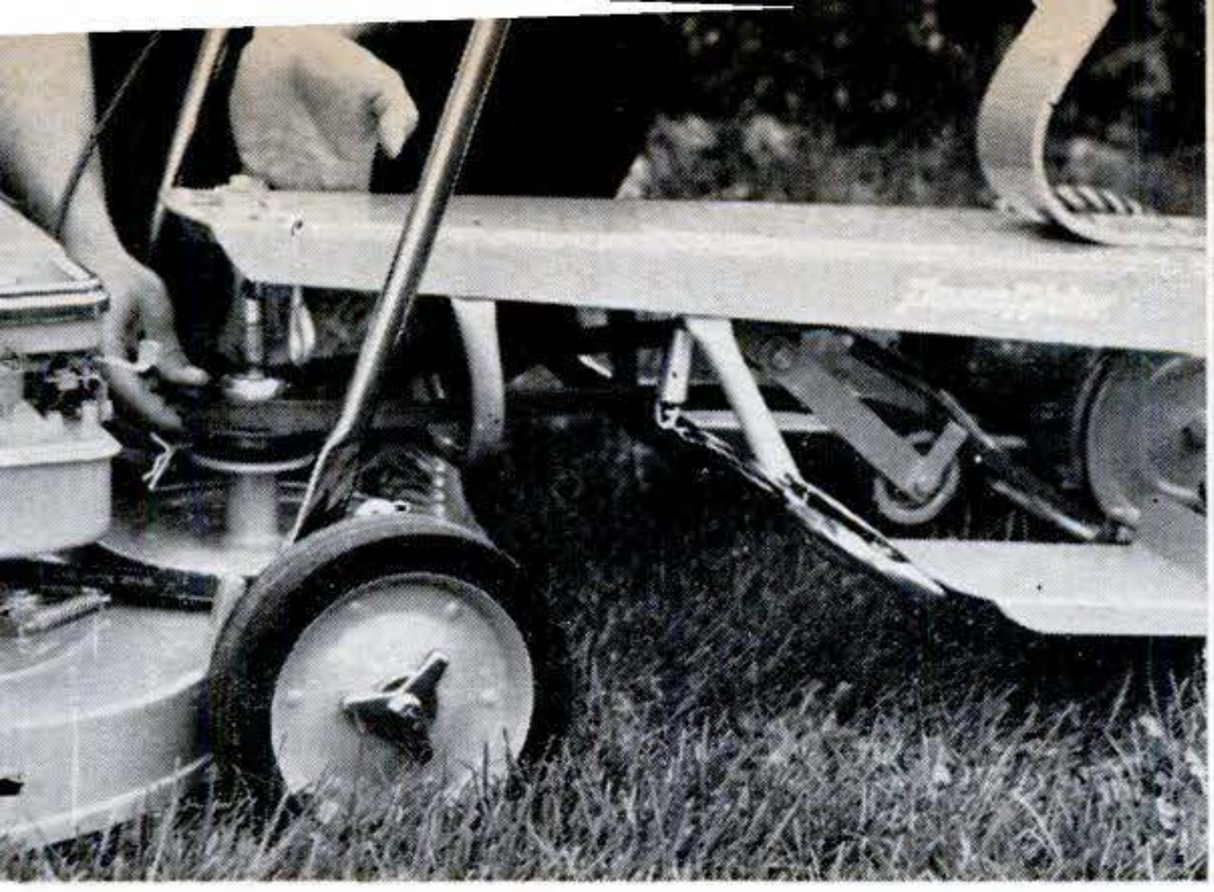

Separate drive belt puts power in the wheels of a sulky that you hook up to a hand-push rotary made by Red Tip Division, Whiz Mow Co., Warsaw, Ill. This belt to the PoweRider wheels pushes you along.

Typical of front-reach riders now on the market is Pennsylvania's 30"-cut Sabre, available with five- or seven-hp. engine. The Sabre has a special frame that flexes to make front wheels adjust to terrain.

in popularity—and the ease of start and use offered by many electrics.

This year it's expected that half a million new riders—reel or rotary—will roll on the nation's lawns. Riders are of two types—walk-behinds with sulkies, and integral, tractor-type machines.

International Harvester has entered the riding field with a spanking-new Cadet 60 powered by six horses. A big, comfortable rider with a fiberglass overbody, the Cadet has an exceptional 24" turning radius and four reverse speeds for close inching and trimming. There are four forward speeds, too. Steering is geared automotive type, with electric starting optional.

For ingenuity and design-for-purpose purity, a Yazoo with 36" cutter is a gem of a three-wheeler chassis. The single wheel is to the rear and the mower deck front is mounted for ready raising and lowering in operation. The cutter deck boasts three shafts and cutters running in ball bearings.

Front-reach riders. More riders are being built to rear-engine, cutter-underneath, front-reach pattern. Good points:

- Engine noise and heat to rear.
- Weight over drive wheels.
- Engine and drive close coupled.
- Good front and side visibility.

But there are disadvantages, too:

- Tendency to rear on a fast start or hill, dumping the rider.
- Cutter deck cannot be angled and pivoted like a front-mount deck.
- Steering not on tight radius.
- Side discharge limits close cut on one side, especially with bag.

Allis-Chalmers has three new rear-engine front-reachers—a five-horse with 26" cut, a five with 32" cut, and a seven-hp. with 32" cut. Controls are good, with a parking brake, separate clutch and brake, five forward speeds, a reverse, no clutching on first through fifth speeds, cutter clutch, and throttle.

Another front-reach model of tubular steel by AMF-HOMKO in the 30", six-hp. size has an especially solid-looking deck-height control system. Fast, easy, and sturdy cutter-deck lifts are hard to find but very important to a user with

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Grass bag is centrally mounted between handles on McDonough Power's new Snapper V21. Bag holds two or three bushels of grass. Remove bag and interlock kills engine until safety deflector is in place.

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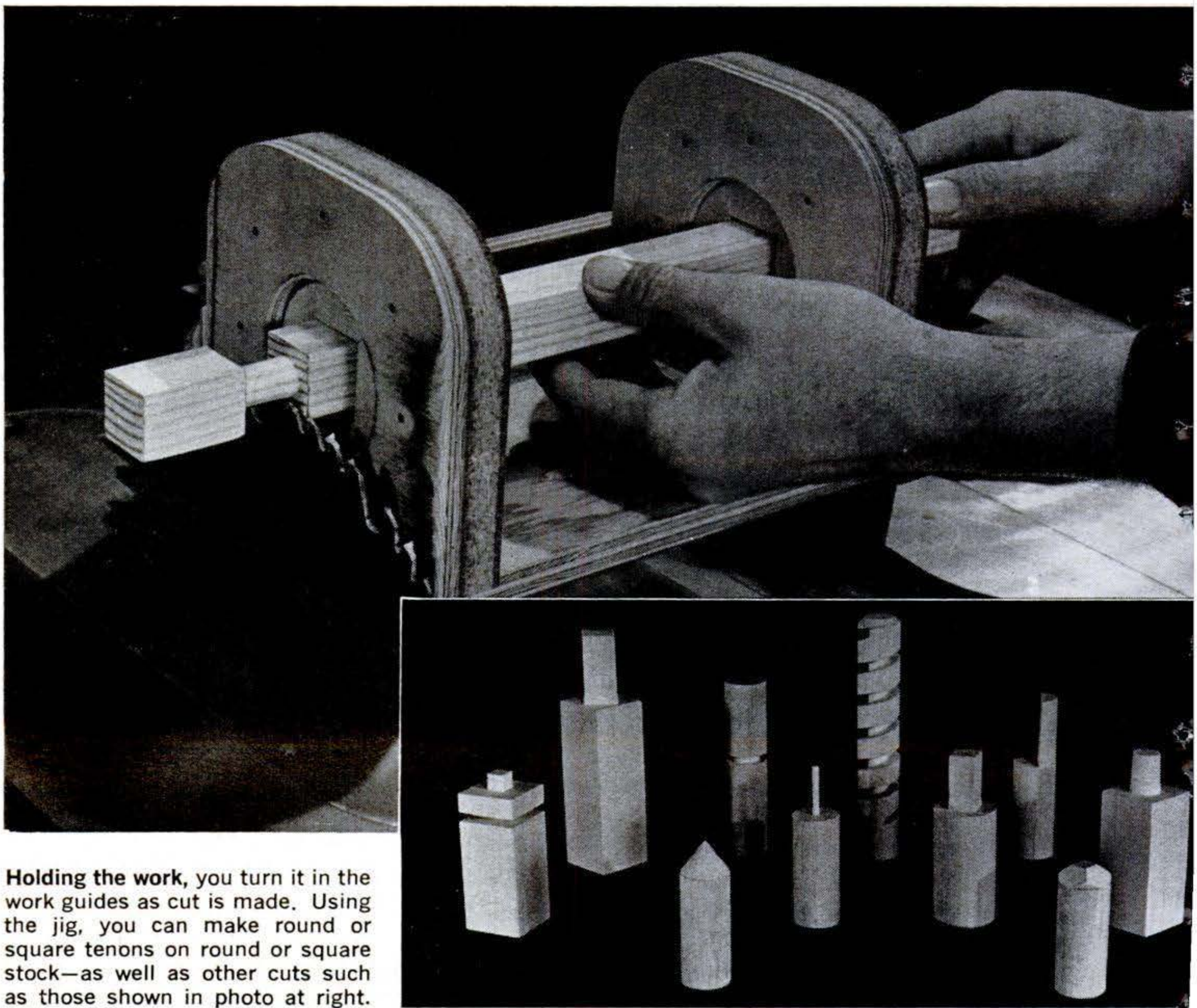

Holding the work, you turn it in the work guides as cut is made. Using the jig, you can make round or square tenons on round or square stock—as well as other cuts such as those shown in photo at right.

HOW TO MAKE A Rotajig for Your

I call this easily made sawing accessory a rotajig. With it you can form both square and round tenons on square stock or on round stock—and do it all on a table saw, working just with a saw blade or dado. It also connects to the miter gauge and works like an extension of the gauge, permitting conventional cross or miter passes.

Once the tool is made, it's quite a challenge to make full use of it. Work guides can be made to hold almost any odd-shaped piece so further cutting can be done accurately and safely. Each work guide you make becomes a permanent accessory for future use on similar applications of the tool.

Making the jig. It's not difficult to make, but accuracy is important. A critical dimension is the distance from the center of the holes in the guide holders to the table surface. As shown in the drawing, it's fine for a 10″ blade with about a 3″ projection. If blade projection is considerably less, you should probably adjust that one dimension to get maximum depth of cut on work held in the jig.

So that they will retain the work guides, make the holders from two pieces of stock with the hole in the thin piece a

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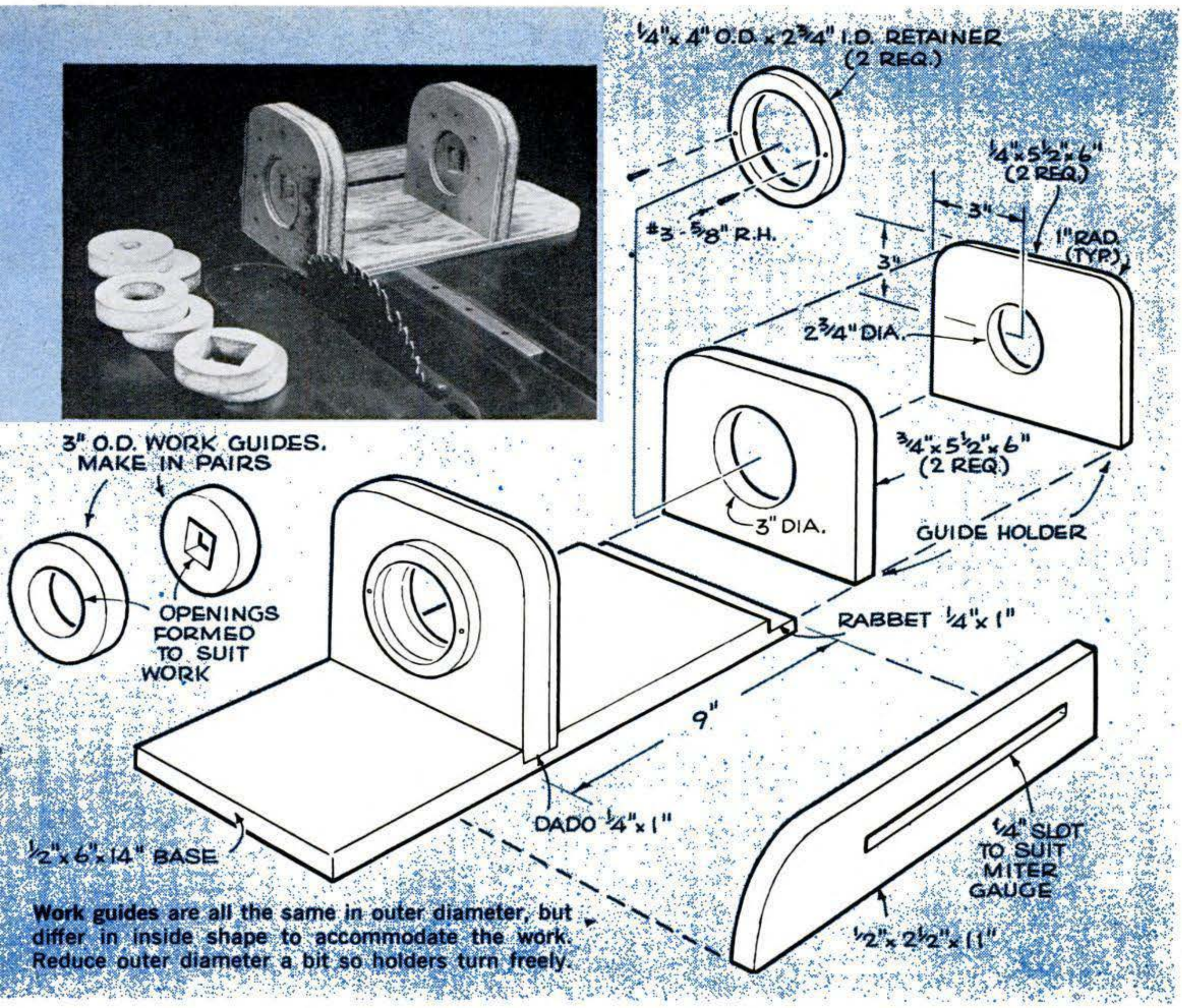

Work guides are all the same in outer diameter, but differ in inside shape to accommodate the work. Reduce outer diameter a bit so holders turn freely.

Table Saw

By R. J. De CRISTOFORO

bit smaller than the hole in the thick piece. Then glue the two together. If possible, form the holes with a fly cutter or hole saw. Lacking these, you can do the job on a jigsaw, but cut undersize and finish with a drum sander. Do the same for the retainers.

No rock 'n roll wanted here. The outside diameter of the work guides should fit them nicely into the holders. It's best to make them from the same material used for the holders and then reduce thickness just a fraction by sanding.

What kind of opening you make in the guides depends on the work—square for square stock, a hole for round stock, or a diamond-shaped opening, cross, quarter-round, rectangle—whatever suits the work shape. Round openings are easily drilled; square ones can be cut with mortising chisels or (true of other shapes, too) with a jigsaw.

You'll find situations where guides can do double duty. For example—if you have made guides with a 1″-square opening, they may be used to work 1″ dowel material.

As far as material for the jig is concerned, neither the jig nor the guides take

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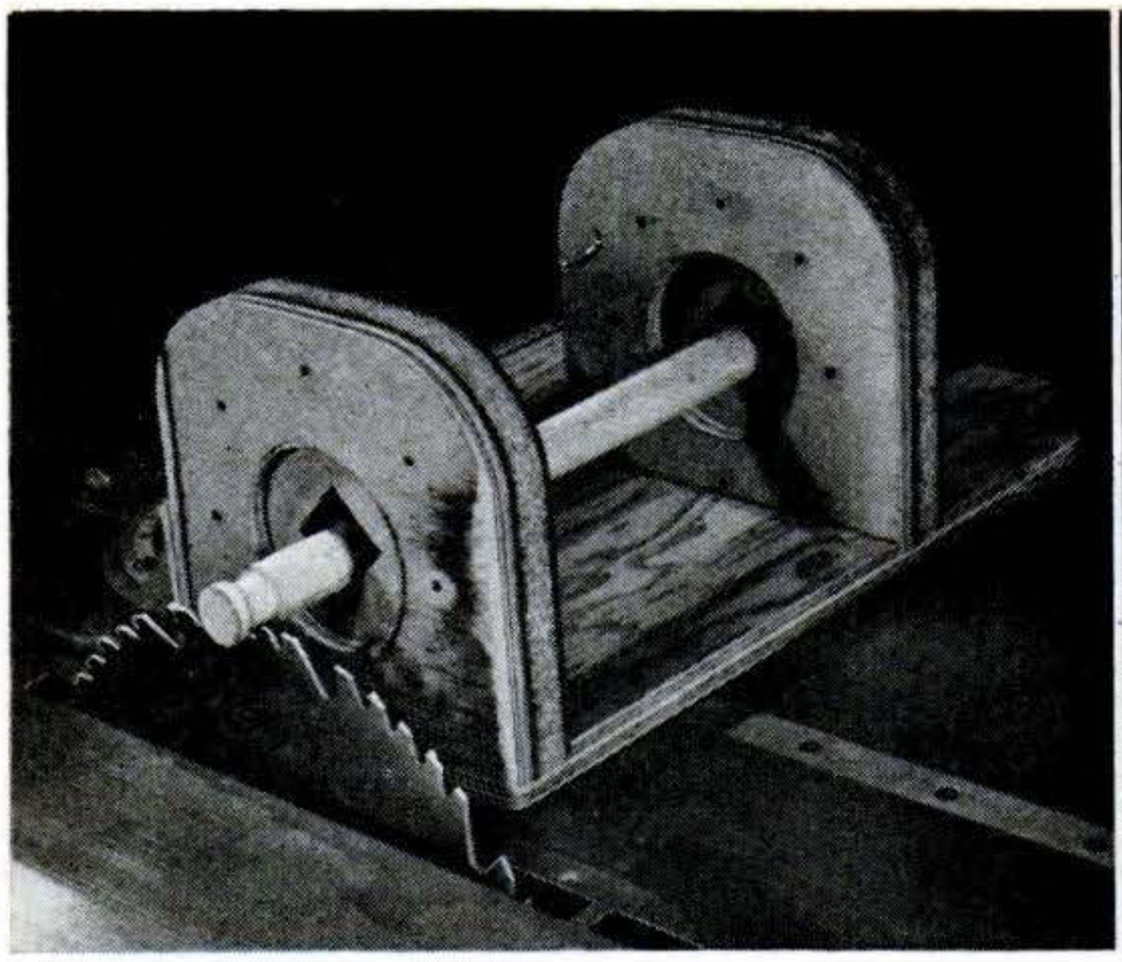
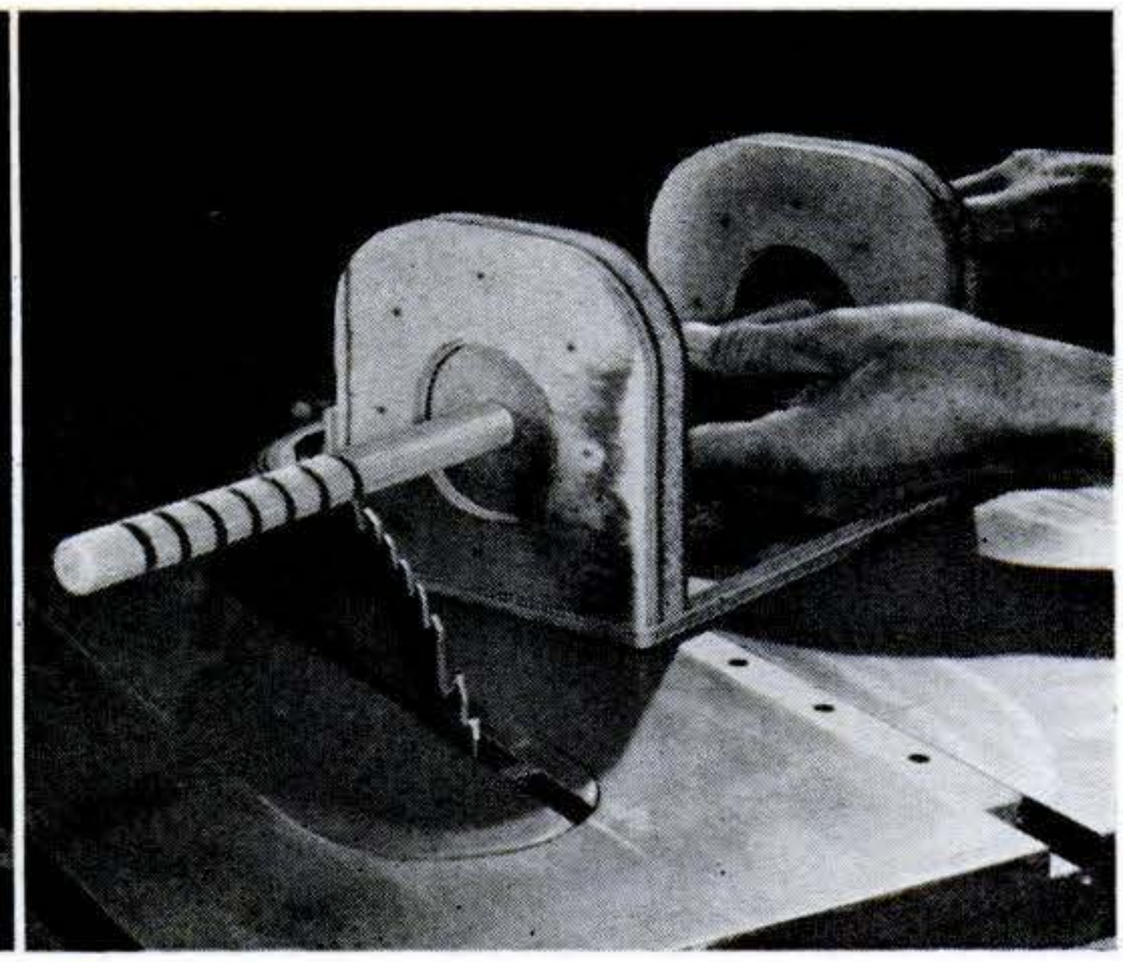
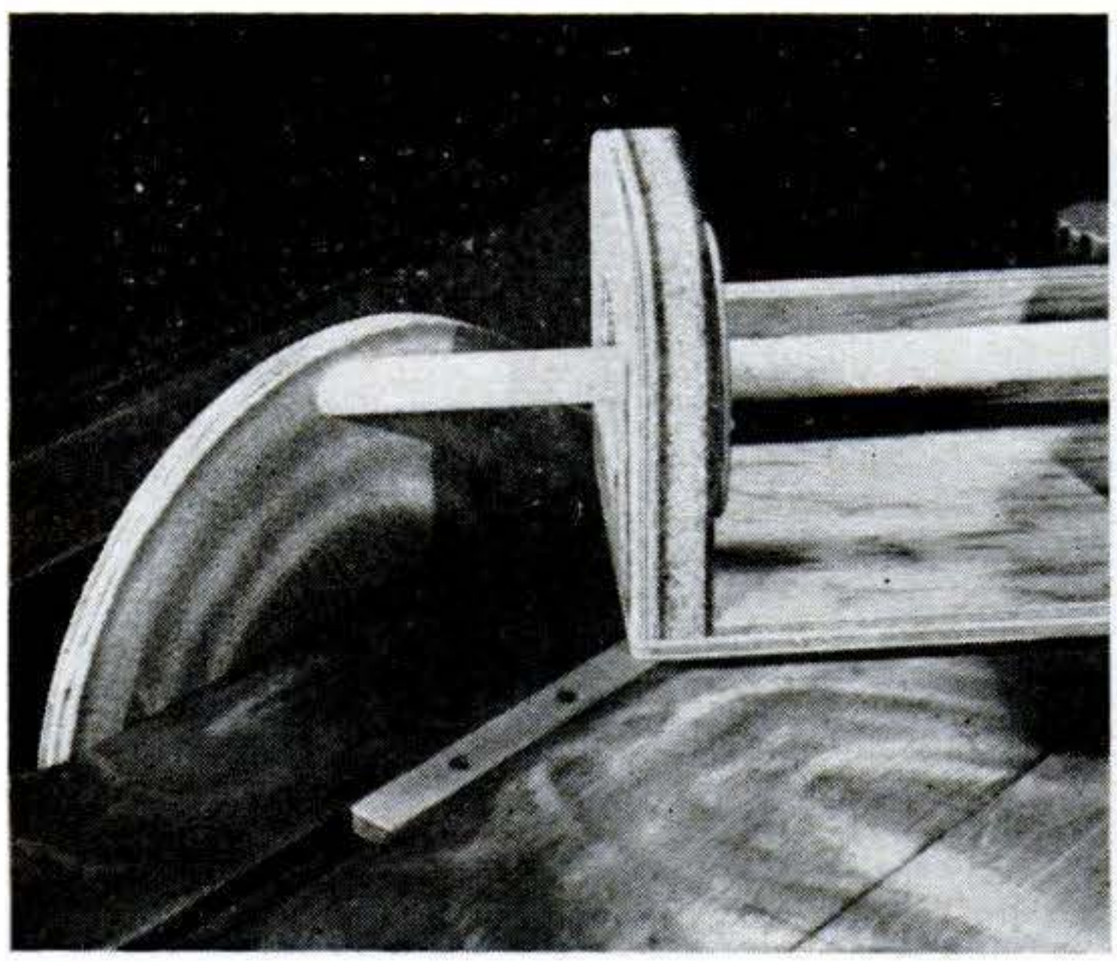


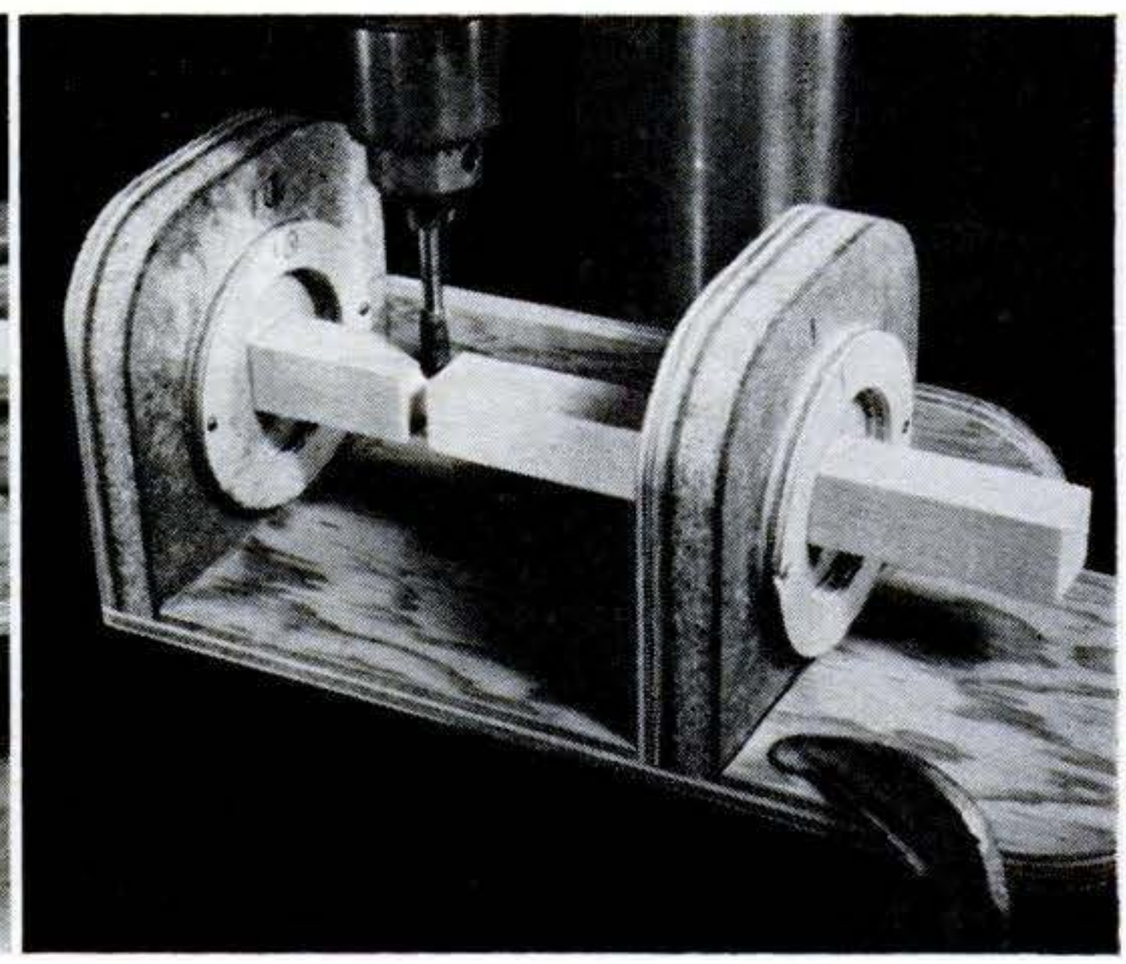
Some work guides do double duty—those in use above have 1"-square openings, but they're fine for holding a 5/8" dowel to reduce its diameter.



For spiraling, set the miter gauge at an angle and slowly rotate the work against the direction of rotation of the saw blade. The work will feed itself.



Substitute a sanding disk for the saw blade and you enter another big work area. Above, end of dowel is being angled. Rotate the dowel for a conical point.



A drill press can also be used with the rotajig, as can a disk sander and bandsaw. You'll find it helpful if basic tool is equipped with a miter gauge.

a beating. So you can choose from odds and ends. But make the parts carefully, assemble strongly, sand smoothly, and then protect with a sealer. Drill holes so you can bolt the jig to the miter gauge for some operations.

Using the jig. To make a round tenon on round or square stock, raise the saw blade to correct height, move the jig forward until the work is over the blade centerline, and rotate the work against the direction of saw-blade (or dado) rotation. It's okay to use the rip fence as a gauge for the first outlining cut.

Should you need to cut a rabbet on round stock, hold the work in a fixed position and make conventional passes over the cutter. Thus, there are two basic procedures—fixing the work and moving the miter gauge.

Spiraling can be done by setting the miter gauge at an angle. Substitute a sanding disk for the saw blade and another area opens up. In using a molding head, remember that with this tool it's best to achieve full depth of cut by working in stages and by feeding very slowly.

Be sure that you provide for the slot in the miter-gauge connect piece since this makes it possible to place the jig close to the cutter to get maximum support for the work. PS

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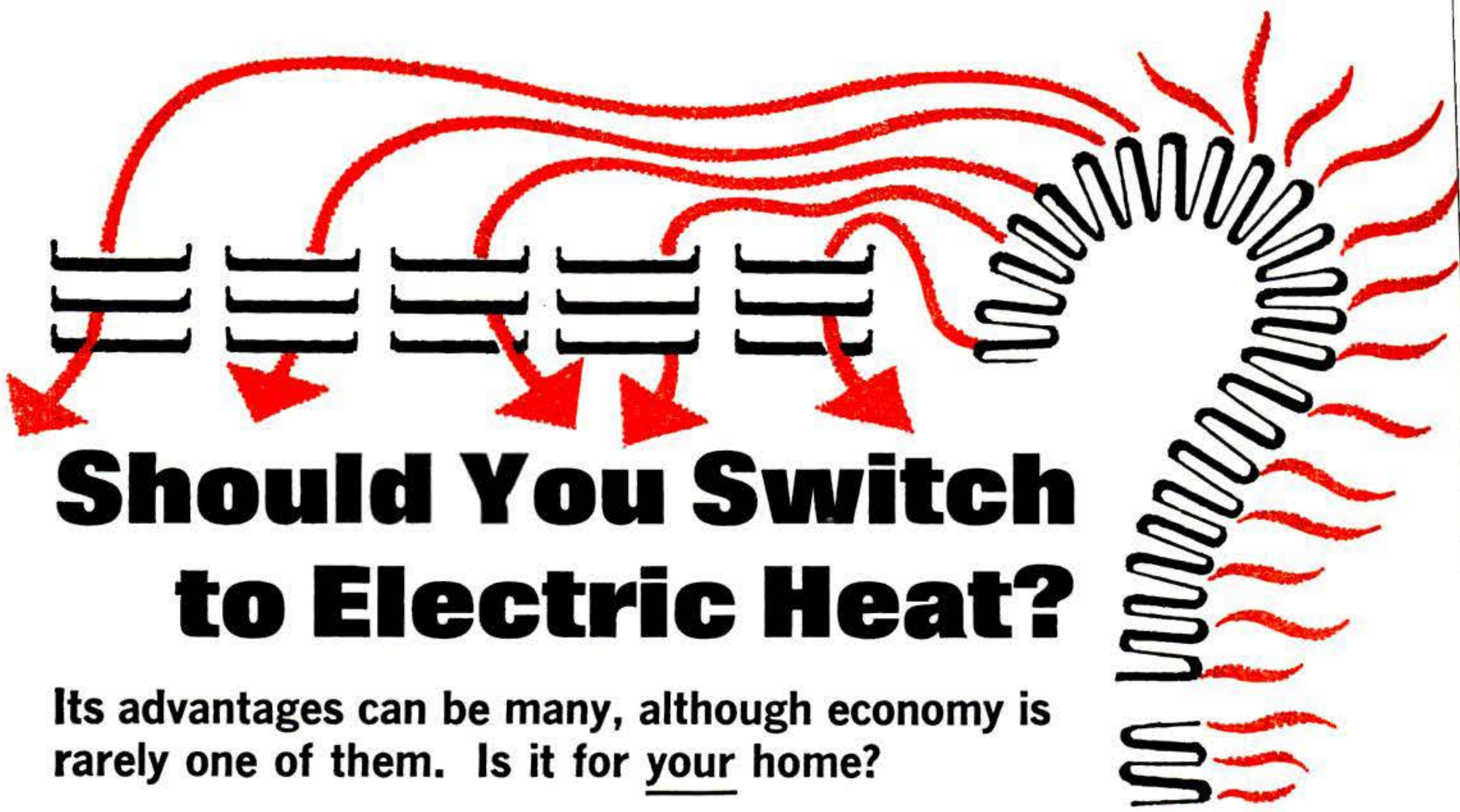

Should You Switch to Electric Heat?

Its advantages can be many, although economy is rarely one of them. Is it for your home?

By DAVID X. MANNERS

For a long time, electric heat was confined to new houses. It was a prestige selling point for glamorous residential developments. Now this system is being introduced into older homes. And it doesn't matter what their age or architecture may be. Older-style houses may actually be easier to heat than new ones.

Most heat loss is through the roof, and older homes usually stack their rooms one atop the other, rather than sprawling them out in one-story ranches and split-levels. That means a correspondingly lower percentage of roof area.

The kind of electric-heat system installed in older homes is not usually the same as that in new construction. Many home owners faced with replacing a worn-out gas or oil system rule out electric heat because they think it involves scrapping their present ductwork or hot-water piping. Not so. One of the great advantages of electricity for heating is its versatility. Flameless heat can take many forms, including a variation on your present furnace that will make use of the existing distribution system. You may even be able to keep your present radiators. All that goes out is the old furnace or boiler.

In converting a warm-air furnace, lightweight duct heaters are put into the blower chamber or existing ducts. No change is needed in the furnace blower. Its efficiency is improved by the conversion. Air blowing through electric coils passes more freely than through the old furnace arrangement, and it heats more rapidly. Booster heaters are installed in ducts near each register. This permits each room to have its own thermostat and temperature setting. Furnaces can be converted to electric heating with a shutdown of as little as two hours.

Keeping existing ductwork. This has advantages because it permits power humidification, electronic air cleaning, and central cooling. In some cases it may be desirable to replace both furnace and blower with a compact new electric furnace, or a heat pump. Again, the ductwork remains the same.

A heat pump is an air conditioner that provides heating as well as cooling. Heat squeezed out of air by a compressor can be directed into the house or turned outside so the house is cooled. Until recently it could not perform under the difficult conditions imposed by northern climates and was used principally where the greater demand was for cooling. Now, new high-reliability pumps have been perfected that will perform creditably under almost any conditions. They can squeeze heat out of air at 20 degrees below zero.

Because they extract heat from air or water, rather than converting electric en-

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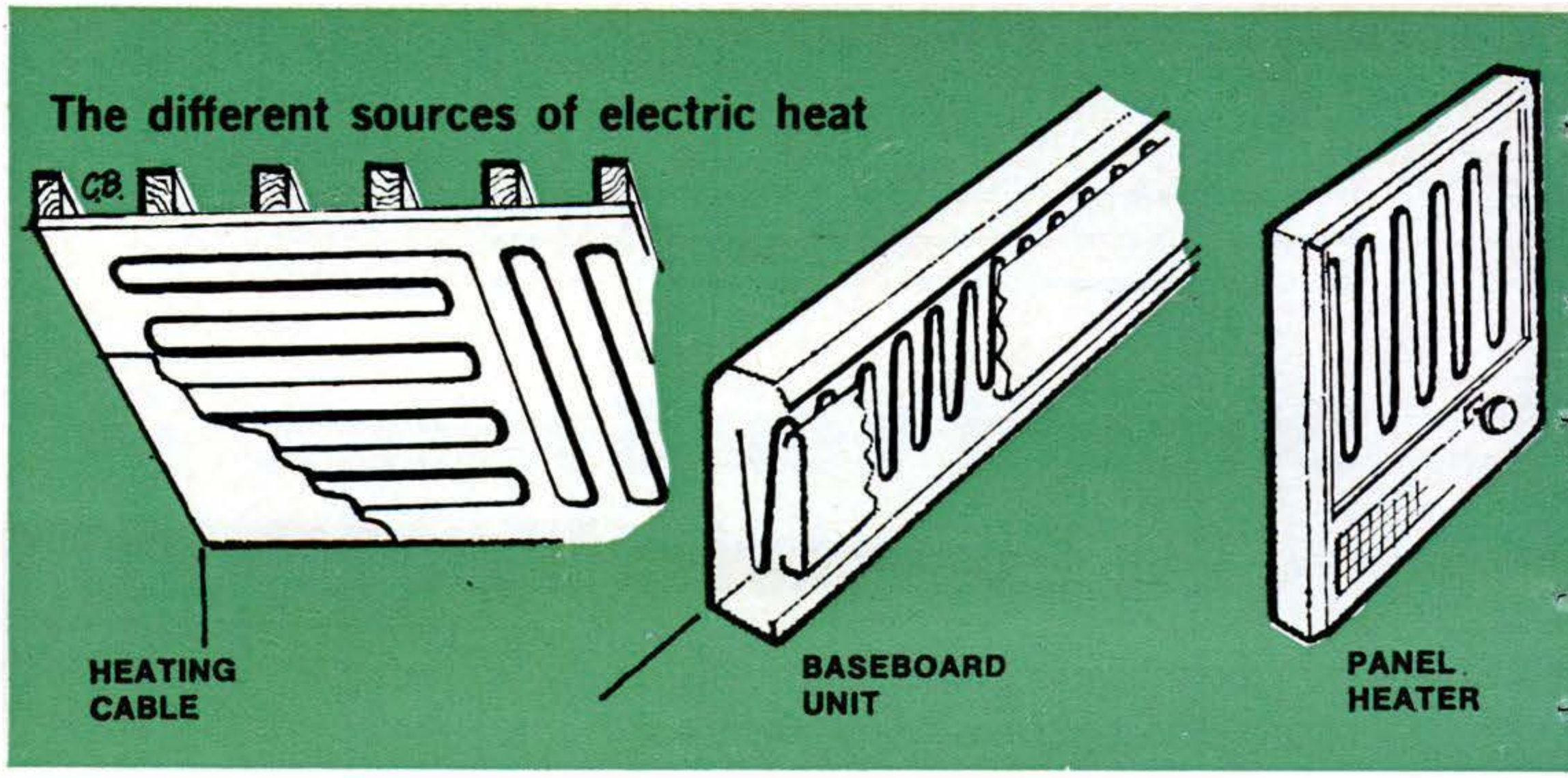

ergy into heat, they can produce more heat per kilowatt of current. A heat pump's operating cost is likely to be 20 to 35 percent less than that of an electric furnace. On one thermostat setting it can either heat or cool to provide the required temperature.

A hot-water system can be electrified merely by replacing the present boiler with an electric one. These are no bigger than a medicine cabinet. They can be hung on the wall, so that no floor space is needed. They can be used with any existing hot-water system—radiant panel, baseboard, convector, or radiator.

Your choice of types. Of course, electric heat doesn't have to be centralized—that's its big distinction as a system. Each room or area can have its own kind of heating, and its own control. In a basement, or where there is a concrete floor, it can be baseboard units. These are especially effective for warming floors, large windows, and masonry walls. In kitchen or bath, where wall space is at a premium, ceiling heaters can be used, or the entire ceiling made into a radiant heater. In bedrooms, window-type heat pumps can offer cooling as well as heat.

In most cases, a mixture of heating types is most desirable. If you abandon a ducted system, that central furnace can go, opening up more space in your basement—perhaps even making a below-grade fun room feasible. And bear in mind, basements can be heated for under half what equivalent space upstairs would cost. At any rate, electric heating for any added space need not be of the same type as in the existing house, and there's no fretting about whether the present system can handle the extra load.

In new construction, ceiling cable is the lowest in material and installation costs. It is merely resistance wire looped back and forth and then plastered over. Or, for a drywall version of the system, you can install gypsum panels with heating wire or copper electrodes already embedded.

After cable, in cost, come wall heaters, baseboard units, and ceiling panels. In converting existing rooms to electric heat, baseboards are the least expensive, followed by wall heaters and ceiling panels. Ceiling cable would, of course, be the most expensive, but there's a new flexible vinyl sheet with woven resistance wire inside that you apply to the existing ceiling like wallpaper.

How about the cost? Even when they're sold on the advantages—and the glamour—of electric heat, many home owners question its cost. Except for a few areas of the country with cheap public power, it's undeniably the most expensive system. Installing it in an older house usually involves other expenses as well, such as adding insulation and changing wiring.

The question then becomes, is it worth

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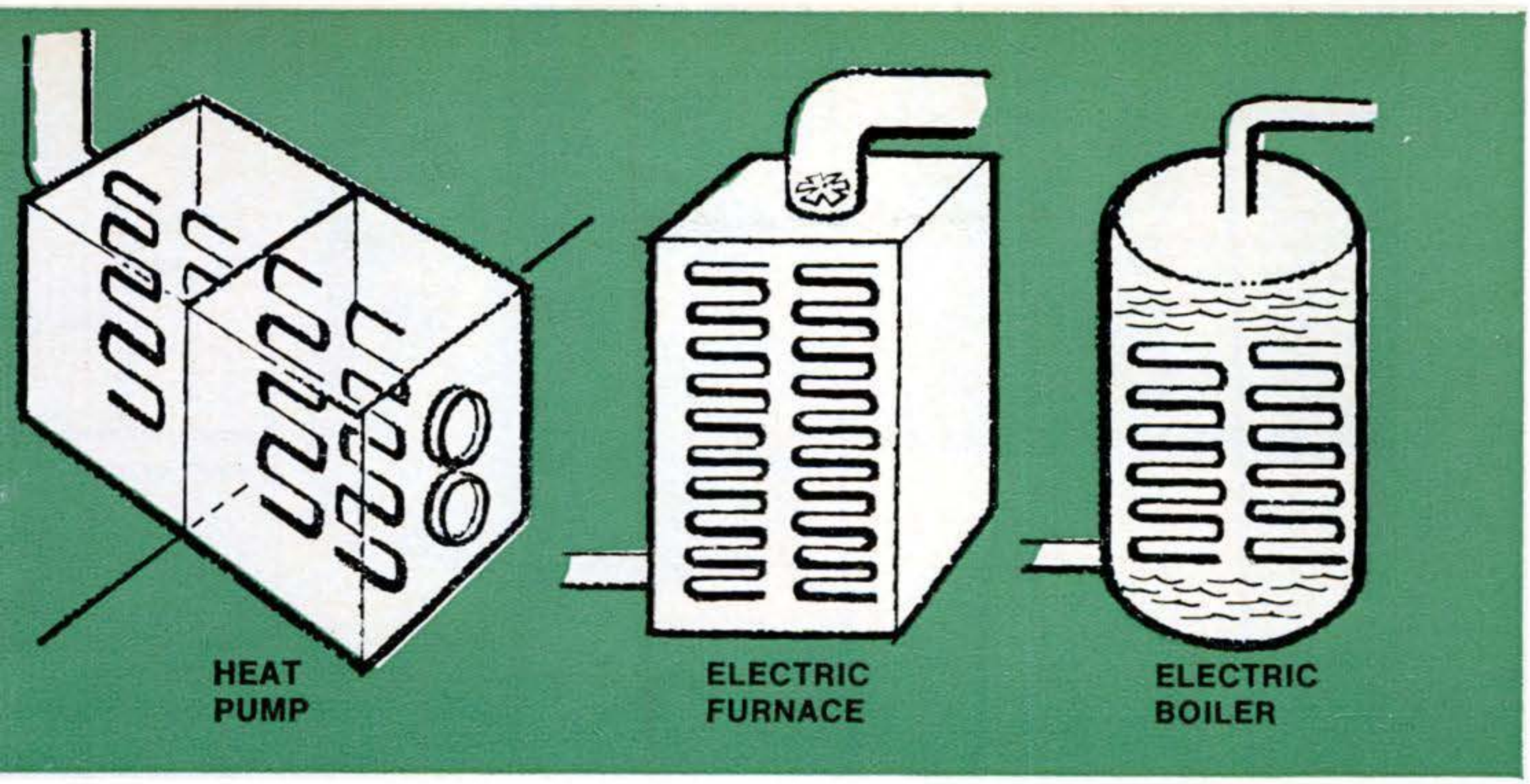

the extra cost, and just how much extra will this be?

For the average house, electric heating will cost $100 more a year to operate than your present system. Since this is an average, the cost will often be under that figure. The only way to get an accurate estimate for your house is to contact an electrical contractor who installs heating. There is almost no risk that operating costs will far exceed what he quotes. For $20 he will sell a three-year insurance policy guaranteeing his estimate within 10 percent.

By rule of thumb, electric heating becomes practical when electric rates for it are 1½ cents a kilowatt or lower. Many power companies now offer this special rate to electrically heated homes. But this doesn't tell the whole story. When a customer is put in this lower-rate bracket because he has electric heating, it means he also gets this lower rate for summer air conditioning. The favored lower rate may also make it possible to enjoy the convenience of being extravagant in other uses of electricity.

He can economically use it to melt driveway ice and snow, to warm a greenhouse or swimming pool, to keep a patio comfortable on cool evenings or marginal days with infrared heat, or to enjoy the relaxation and health benefits of a sauna.

In winter, an electric-heat consumer, with his favored rate, no longer need go around switching off lights in unoccupied rooms. If he wishes, he can have his entire house as completely lighted by night as by day. An electric bulb is a good converter of electricity into heat. Since he'd be heating anyway, the light is a free by-product.

It's not all gravy. The cost of adapting a house for electric heat is another matter. Few older houses are well enough insulated. For electric heat, typical insulation requirements are six inches in the roof, four inches in outside walls, and three inches in floors over unheated space. Storm sash or insulated glass is needed at all windows, storm doors at all outside entrances.

Few older homes have adequate electric service to handle heating. A 150-200-amp service, or more, is required. This means a new meter socket, heavier lead-in wires and conduit, and a new, bigger circuit-breaker box. Some utility companies offer a $150 wiring allowance to help defray such costs.

By another rule of thumb, you can figure it will cost about $1 per square foot of living space to convert to electric heat. A recently converted 2,800 square-foot house in Connecticut followed this rule almost exactly, with an expenditure of $2,880. Of this amount, $1,960 went for a 200-amp service, wiring, and heating units, $550 for added insulation, and

[Continued on page 210]

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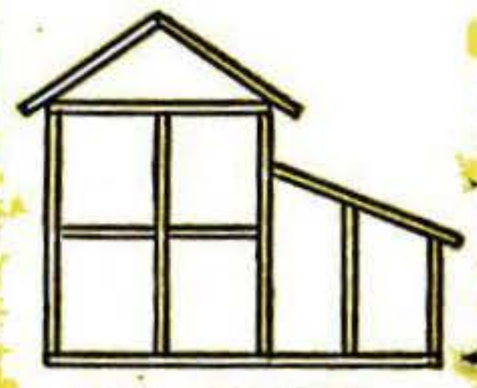
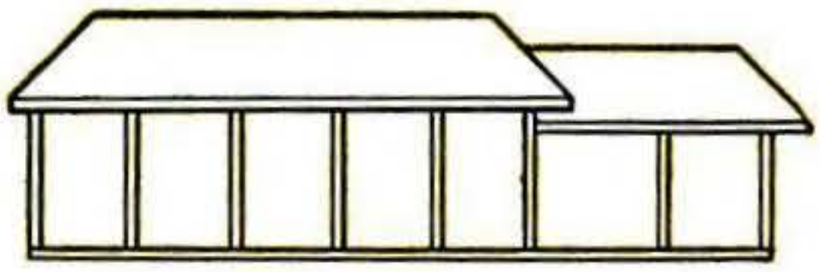
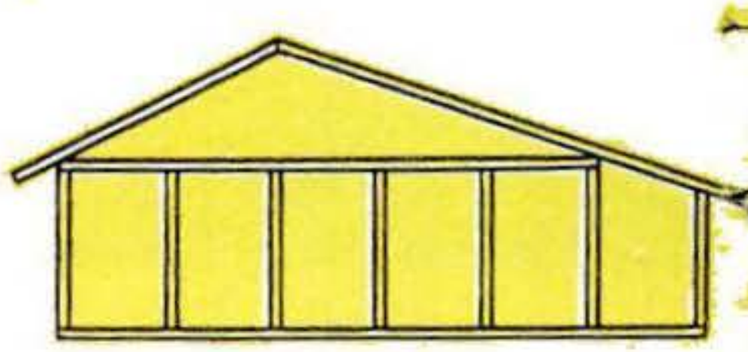


TWO-STORY



RANCH

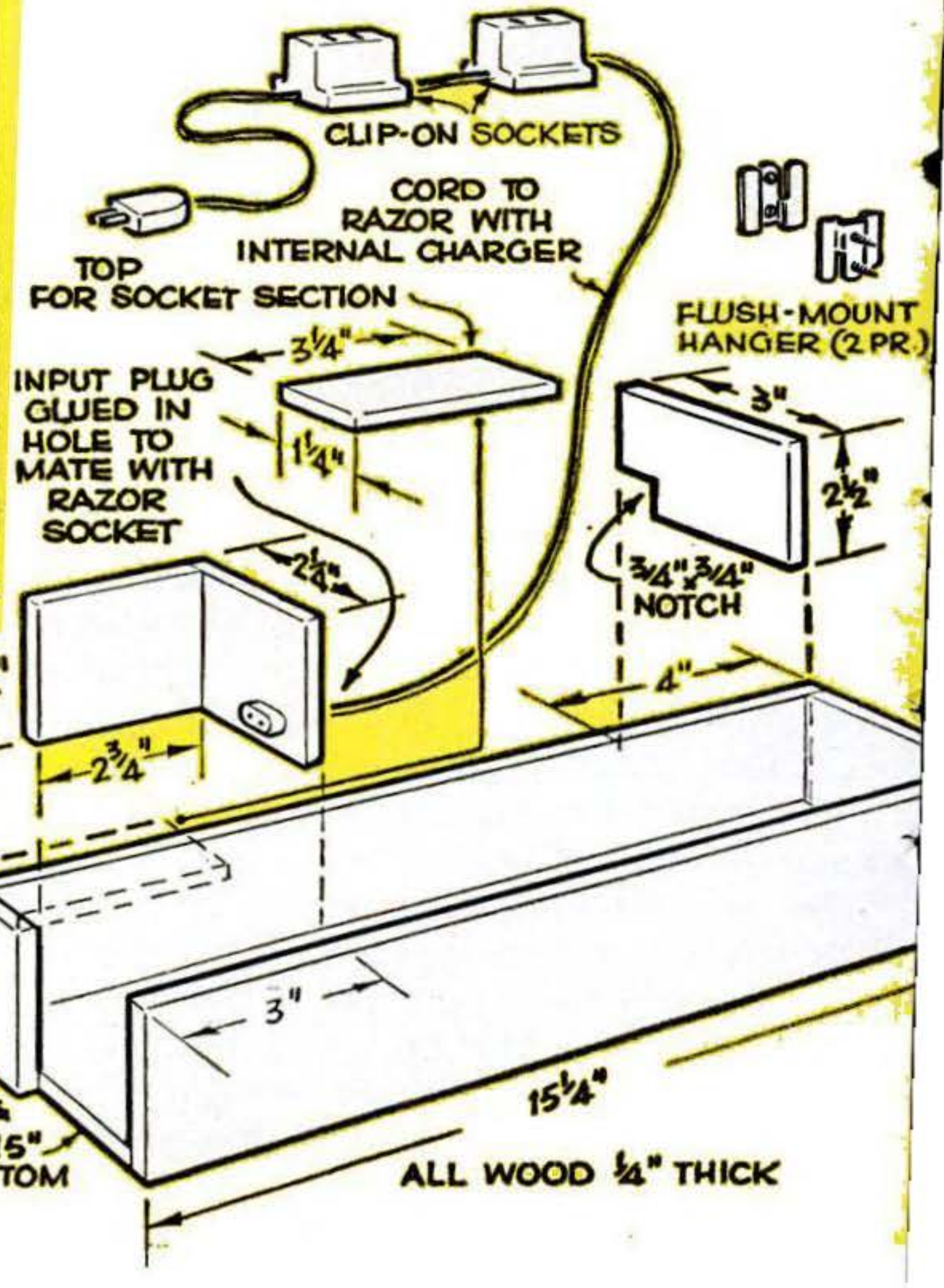
GARAGE



MODERN

PS PROJECTS

5 Easy Things to



2. GROOMING TRAY

Tired of the tangle of bathroom appliance cords? Mount this unit with built-in outlets and tuck electric toothbrushes and razors in their own compartments. Sample dimensions are given for three battery-operated units. The end razor has a self-contained charger, so needs a mating outlet.

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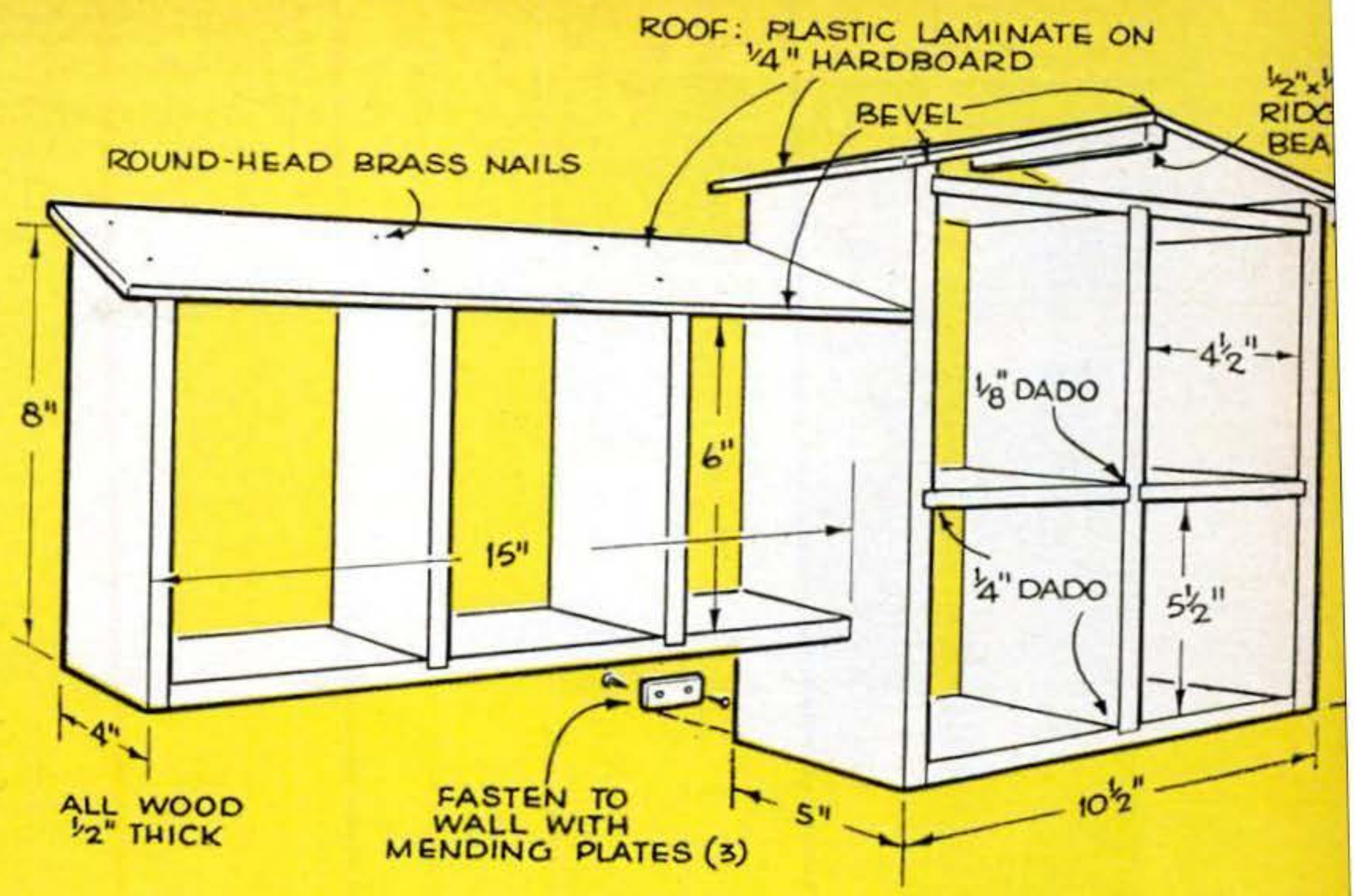
1. COFFEE HOUSE

The coffee-mug craze has left many homes with mugs that have too much appeal to be hidden away. One clever way to display them —and keep them handy for use—is a wall-hung mug house styled to match the architecture of your home. The photo shows a rack built of walnut and scrap counter-top laminate, to match a split-level house. From the basic dimensions at right, the other sketches (at left) can be adapted.



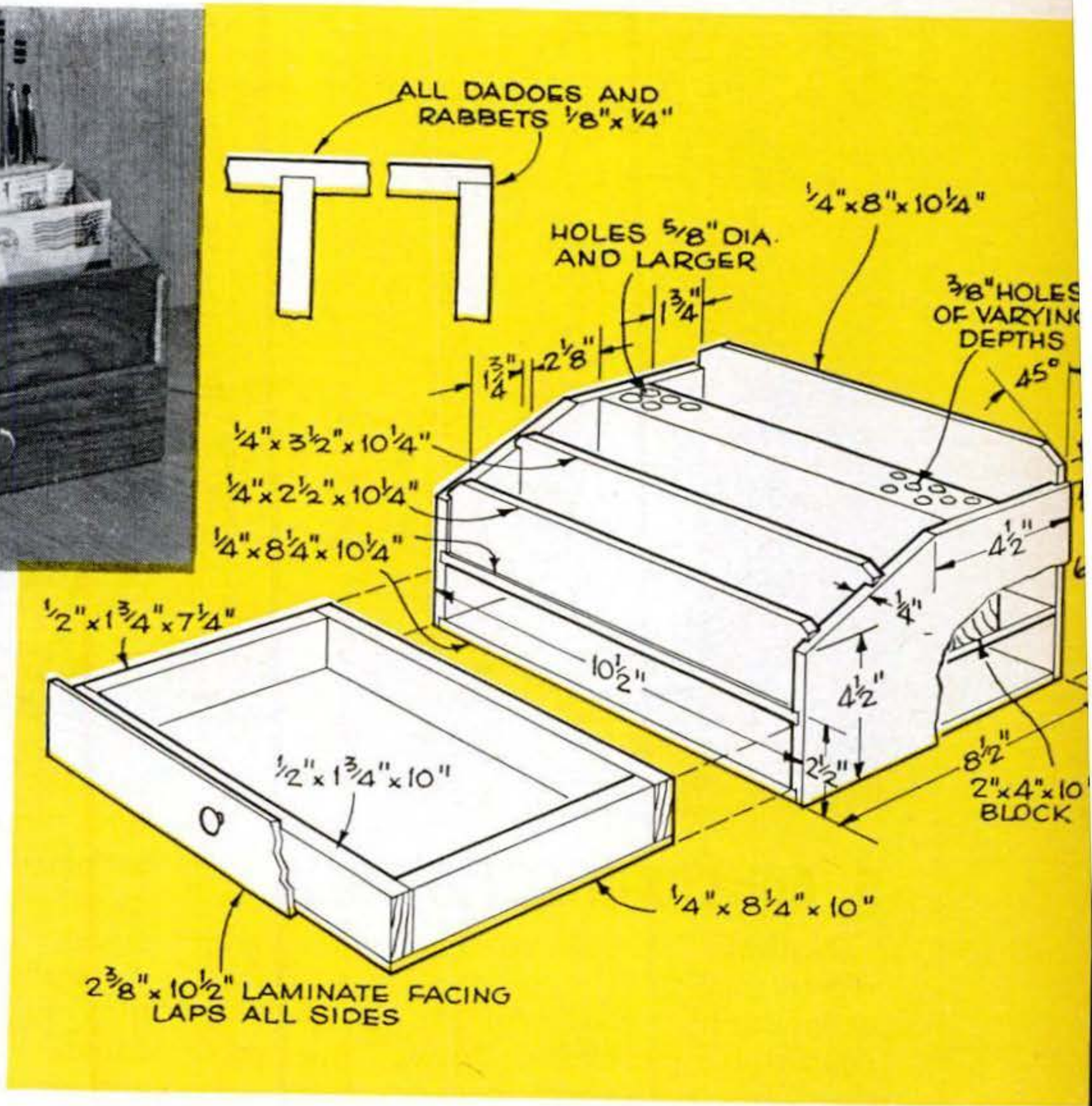
SPLIT-LEVEL STYLING

Make for Your Home

3. DESK CADDY

All those items that tumble around in desk drawers are stored neatly in this unit made from scraps of walnut paneling, or other plywood. It also organizes your stationery and separates correspondence from bills. The drawer holds stamps, paper clips, and rubber bands.

Continued



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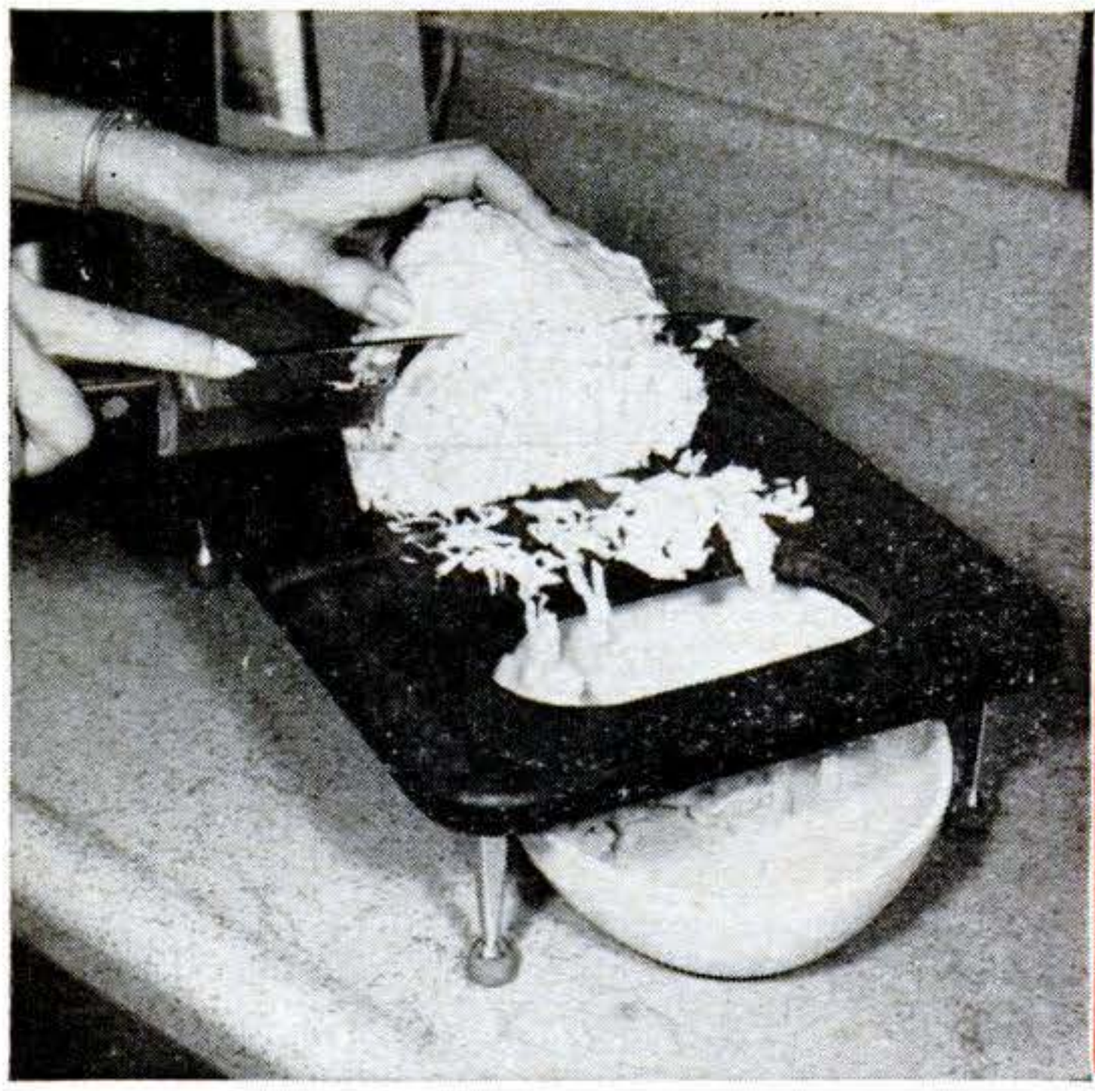
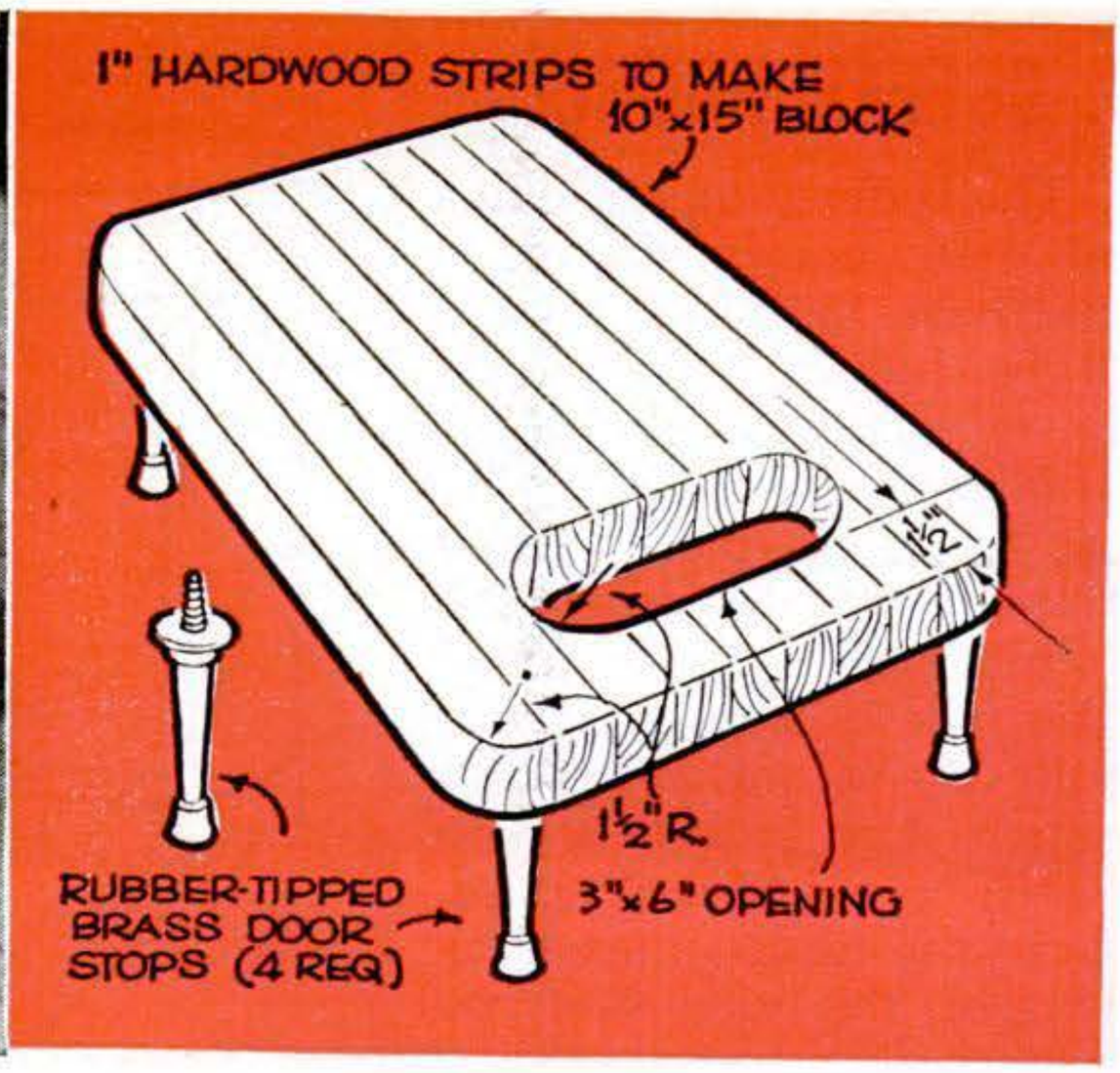
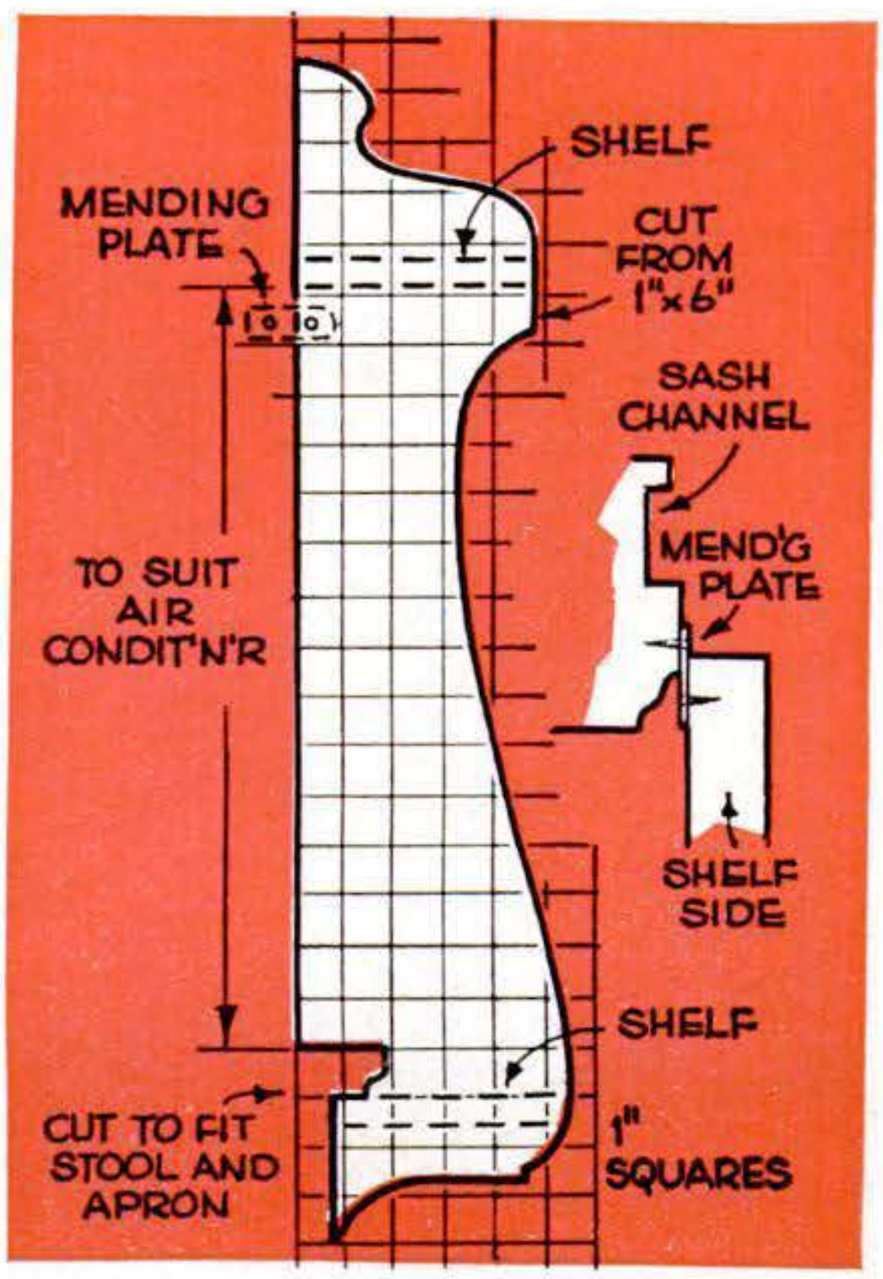
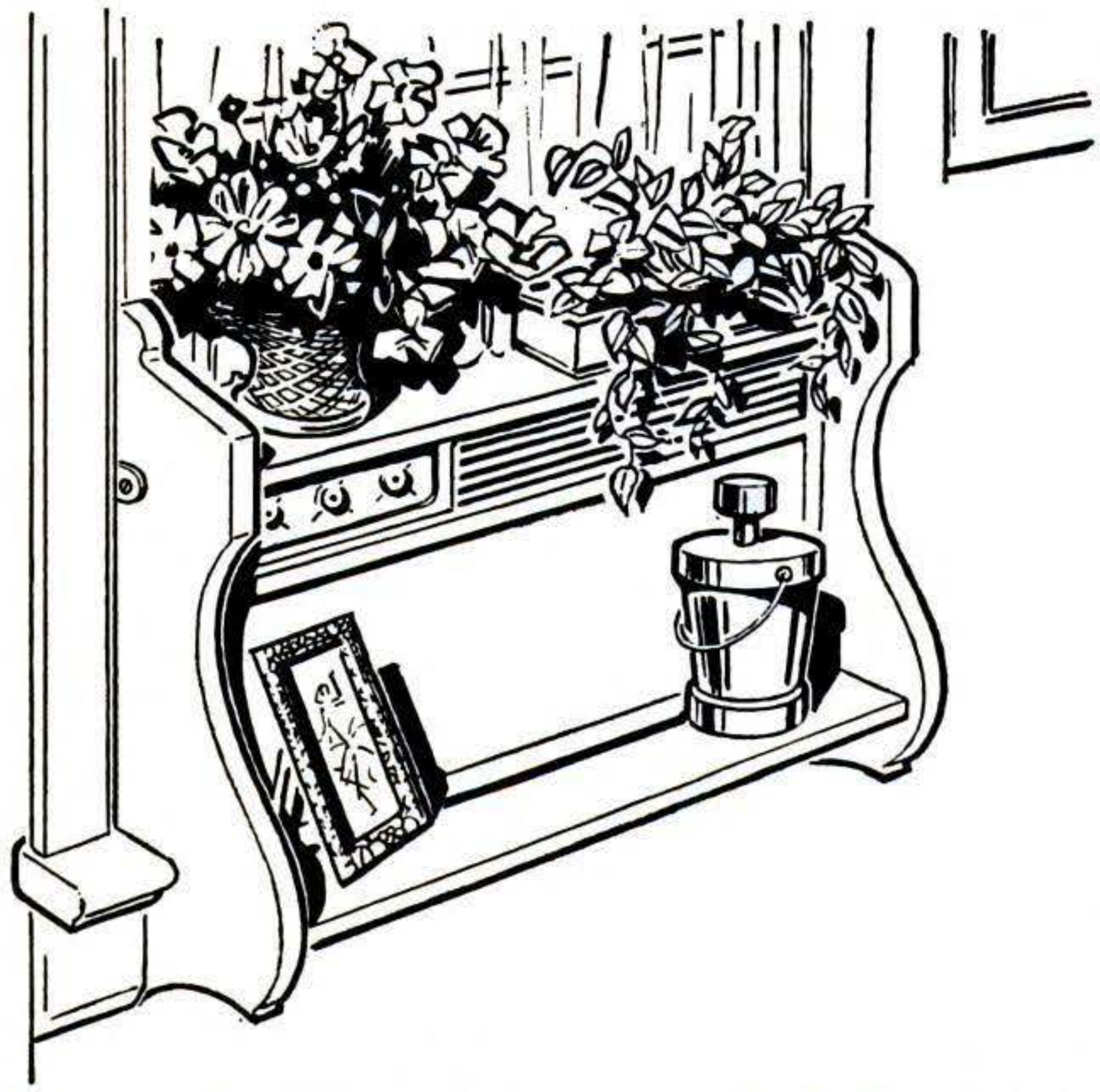




4. SLICING PLATFORM

Strips cut from hardwood scraps, assembled with waterproof glue into a 10"-by-15" block and mounted on rubber-tipped legs, will rate cheers from your wife. It's ideal for slicing, chopping, and dicing. The feet prevent sliding or marring, and the hole near one end funnels the cut-up food directly into a bowl, slipped beneath. Slice any 1"-thick hardwood—walnut, oak, maple—into 1" strips and glue and clamp these face-to-face, preferably to present all end grain. After shaping and sanding, apply edible oil or a special salad-bowl finish.





5. AIR-CONDITIONER SHELF

Nothing intrudes so much on a cozy room—especially a room with a period decor such as Early American—as an air conditioner thrusting through the window. It's particularly true if you leave it in place all year round—during winter months it's a functionless eyesore. Assuming it's a front-blower unit, you can camouflage it nicely—and get handy display space—with a shelf built around it. Make the shelf of pine to fit the window, and finish it to match the trim.

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Shop Talk

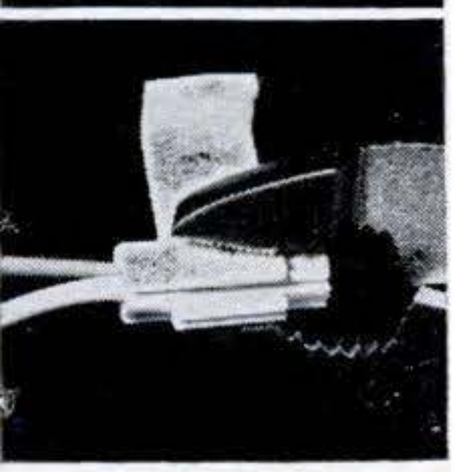
By ROBERT P. STEVENSON

Something new has been added to Homasote panels—color

You can build just about anything, indoors or out, with Homasote building board. That's been true for a long time. Now the company speeds up projects by saving you the finishing time. Building-supply dealers have 2′-by-4′ carry-home Homasote panels coated with acrylic latex paint in green, barn red, beige, and snowy white. Larger panels up to 5′ wide and 14′ long can be ordered. If you've never worked with Homasote, ask your dealer for a copy of the 64-page Homasote Handbook. The company also offers working plans for playhouses, back-yard storage structures, boathouses, even a vacation house. Send 10 cents to Homasote Co., Trenton, N.J. 08603, for their handyman guides.

Some excellent additions for your home-shop library

If you sometimes frame pictures, you can get good tips from a six-page guide, "25 Exciting Fun-to-Make Picture Frames." Send a quarter to Western Wood Molding Producers, Portland, Ore. 97225. Section patterns show how to combine stock moldings . . . Next time you want to apply a natural finish to wood, don't overlook the advantages of linseed oil. A brochure telling about it is available from Spencer Kellogg Div., Textron, Inc., Buffalo, N.Y. 14240, or local Spencer Kellogg dealers . . . To get full value from a staple gun, you ought to have the booklet, "Tips for Tacking," sent free by Swingline Inc., Long Island City, N.Y. 11101. . . A catalogue describing books and magazines for the home shop is available without charge from Rockwell Mfg. Co., 880 N. Lexington Ave., Pittsburgh, Pa. 15208. I'd especially recommend the Deltacraft "Getting the Most Out Of" Handbooks for various power tools. Individual $1 books are devoted to such tools as circular saws, radial saws, and drill presses.



Low-voltage hookups are easier with new electrical connector

Pliers are the only tool you need to make fast and dependable low-voltage hookups with 3M's new Scotchlok electrical connector No. 560. You skip all stripping and soldering. A side slot lets you slip the polypropylene case over the wires. A U-shaped metal connecting element is then driven deep into the case with pliers (see photo), the element shearing through the insulation and spanning the two wires in a firm electrical contact. As a final step, you snap the hinged cover down over the top edge of the metal element, and the plastic packet provides full insulation. The devices can be used for tap, in-line, or pigtail connections in 18- to 14-gauge wires in homes, autos, boats—any low-voltage systems. Four connectors cost 49 cents.

New products that you shouldn't miss

The Minwax Company has just announced a spray-can addition to its line of easy-to-use finishing products—Minwax Antique Oil finish. This clear material produces a hard finish with a soft luster. If you can't find it locally, write the Minwax Co., 72 Oak St., Delawanna, N.J. 07014 . . . The Pittsburgh Plate Glass Co. is so confident of the durability of its new line of nylon paintbrushes that it sells them in a jacket with the legend: "Guaranteed for Your Lifetime." In six sizes from 1″ to 4″ wide, the brushes sell for $3.98.

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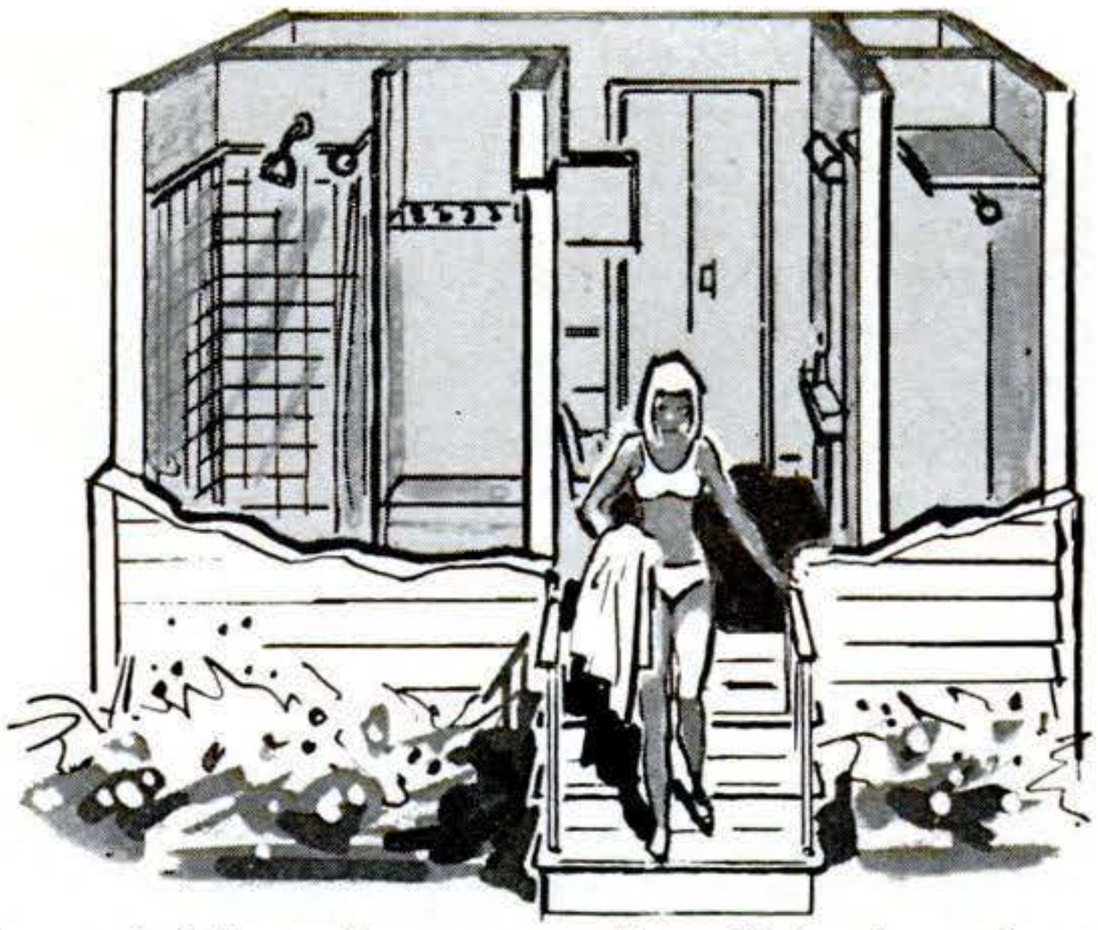
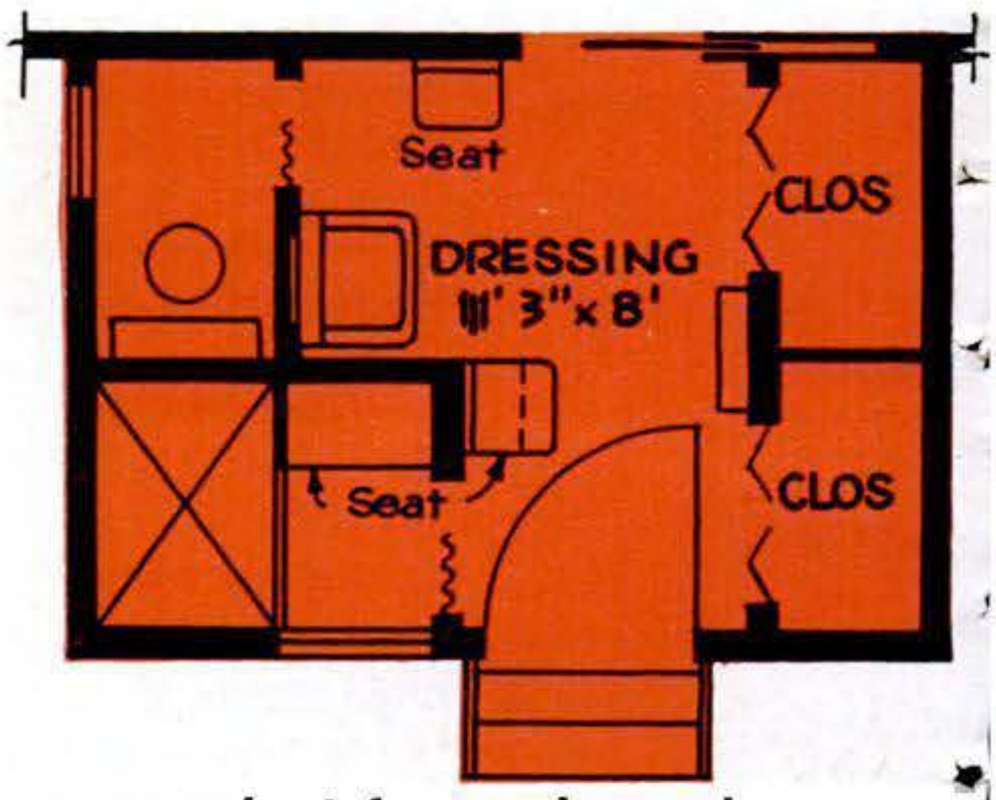
A DRESSING ROOM: Solutio

Your master bedroom can easily become living-in-comfort quarters fo

By CARL T. SIGMAN
Drawings by Sigman-Ward, Inc.



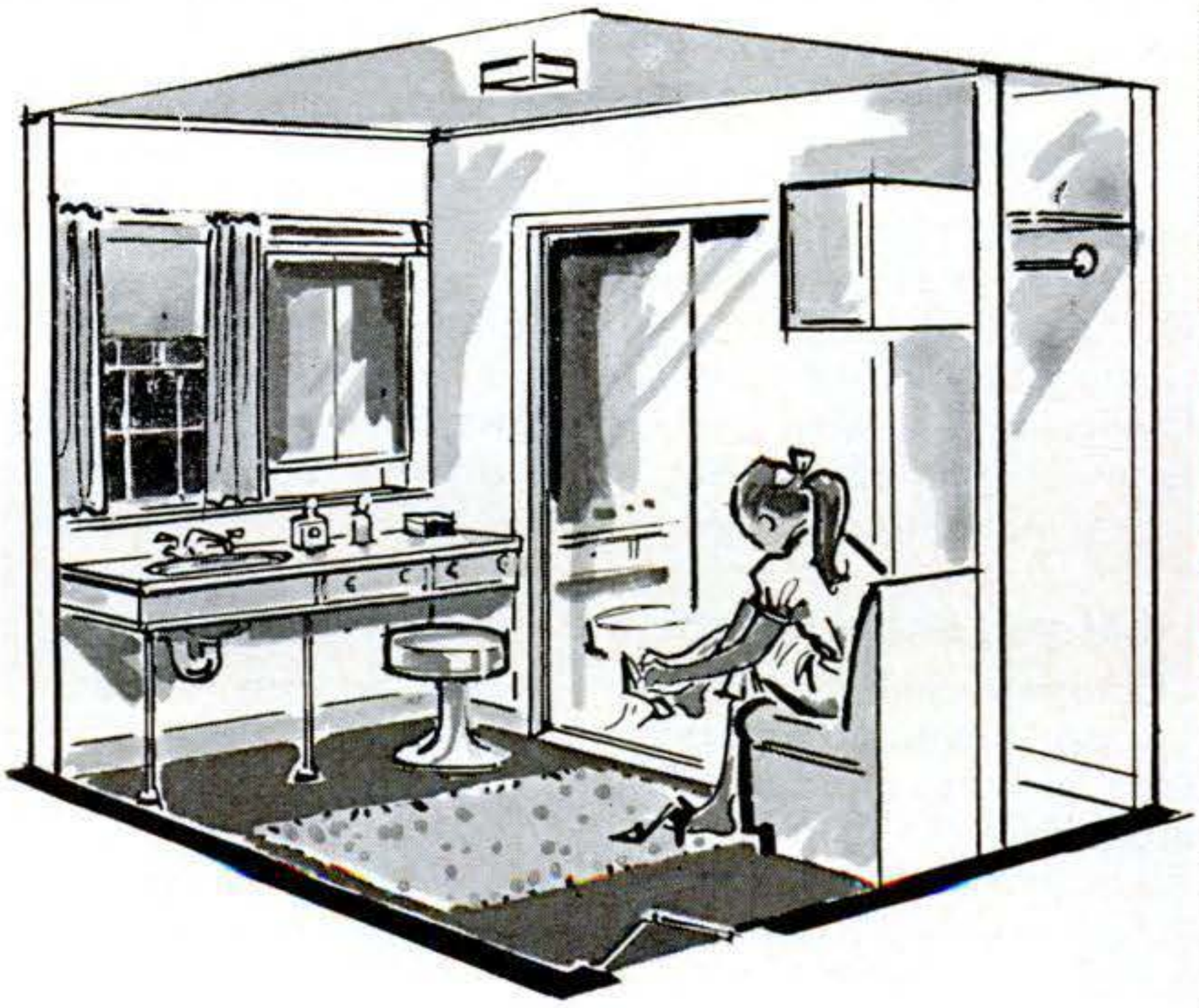


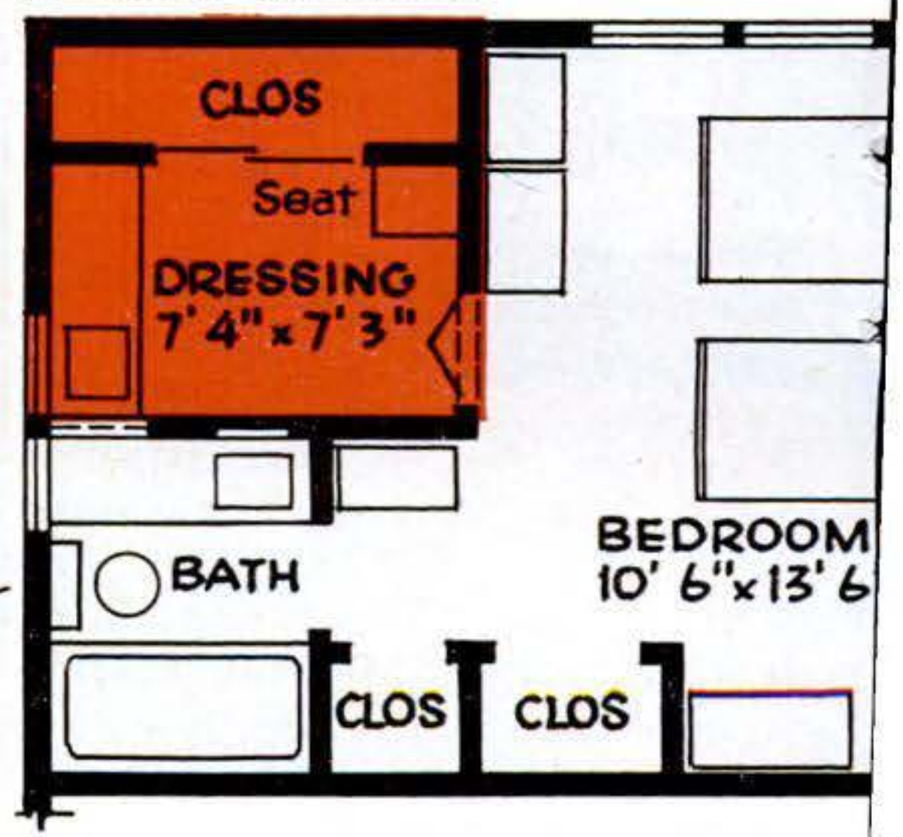
An outside entrance makes this dressing room convenient for work or play

All your outdoor activity is at the doorstep of this addition. In its 102 square feet are a shower, wash basin, toilet, and two closets. It should have an 8′ ceiling; a 12/4-pitched shed roof with a 2′ overhang over door and window. Use composition shingles over two-by-six rafters covered with ½″ plywood sheathing. For the floor, lay ½″ plywood over two-by-six joists, 16″ on center, then vinyl tile over felt underlayment. Use gypsum board for the walls; plastic tiles for waterproofing around the shower.

If your house has an unfilled corner space, why not grow into it?

Got a bedroom with a corner bath but little space when two are dressing? This 57-square-foot addition gives your wife a closet and lavatory vanity of her own; you gain a wall cabinet and a seat. One corner window is reset over the new basin. If you're building on, use a flat roof, framed with two-by-six joists, and roll roofing; or slope the roof down to just over the reset window. Use sliding doors for the closet and a bifold door at the bedroom entrance.





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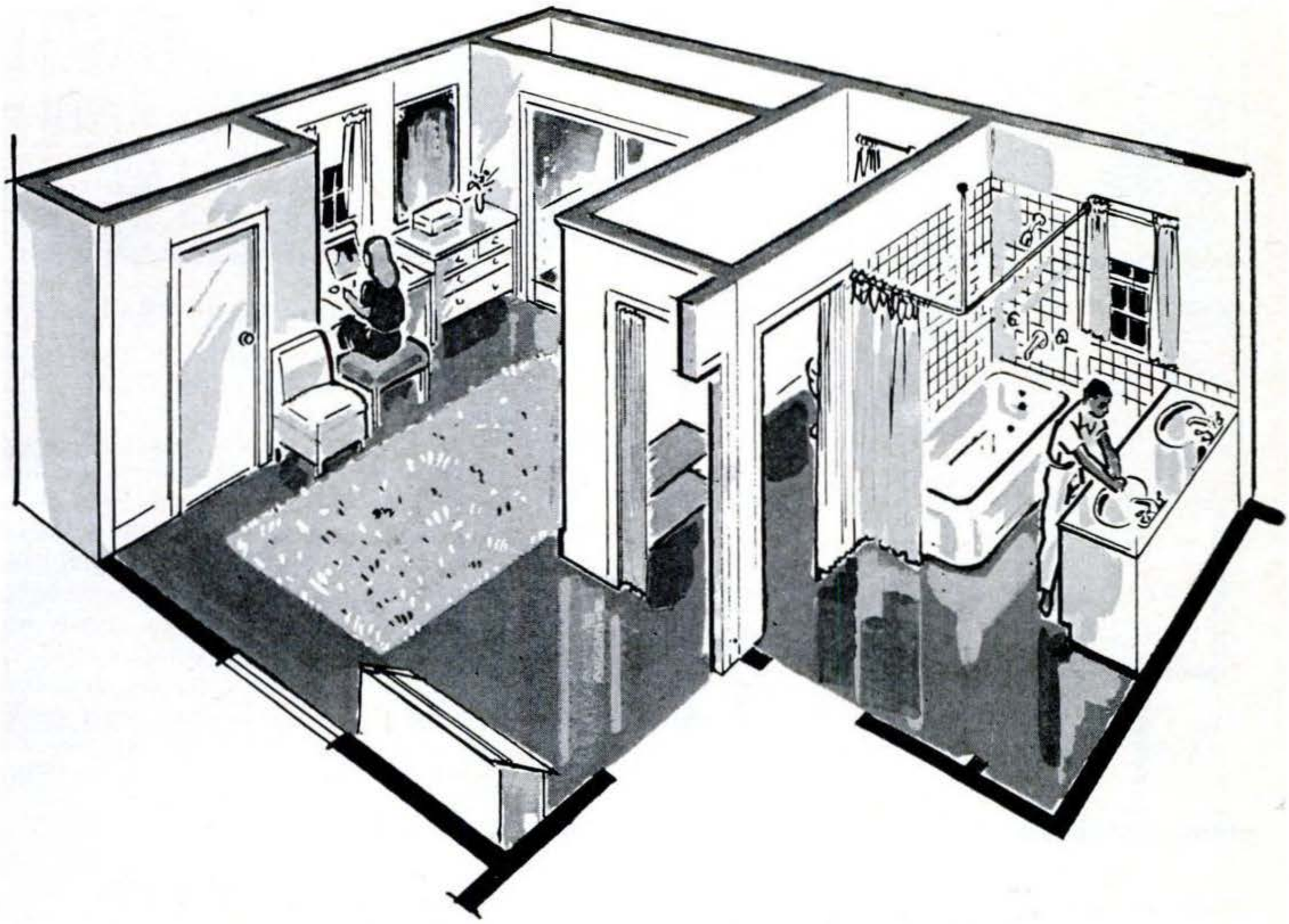
to Your Space Problem?

ou and your wife. Here are six practical remodeling ideas



With this layout, a husband and wife can stay out of each other's way

If your bedroom is big, but has no private bath and too little closet space, a corner taken out of it will make a bath; and a corner of an added-on dressing room, a toilet. In the addition also is a huge closet for your wife, a vanity with a fold-down top, and a chest. There's another chest and closet for you. Each of you has a built-in shoe rack and a chair for putting on shoes and socks. The new construction outside the bedroom covers 168 square feet; the bath took 113 square feet away from the original bedroom. Accordion-fold doors close in the bathroom, which is partially tiled.

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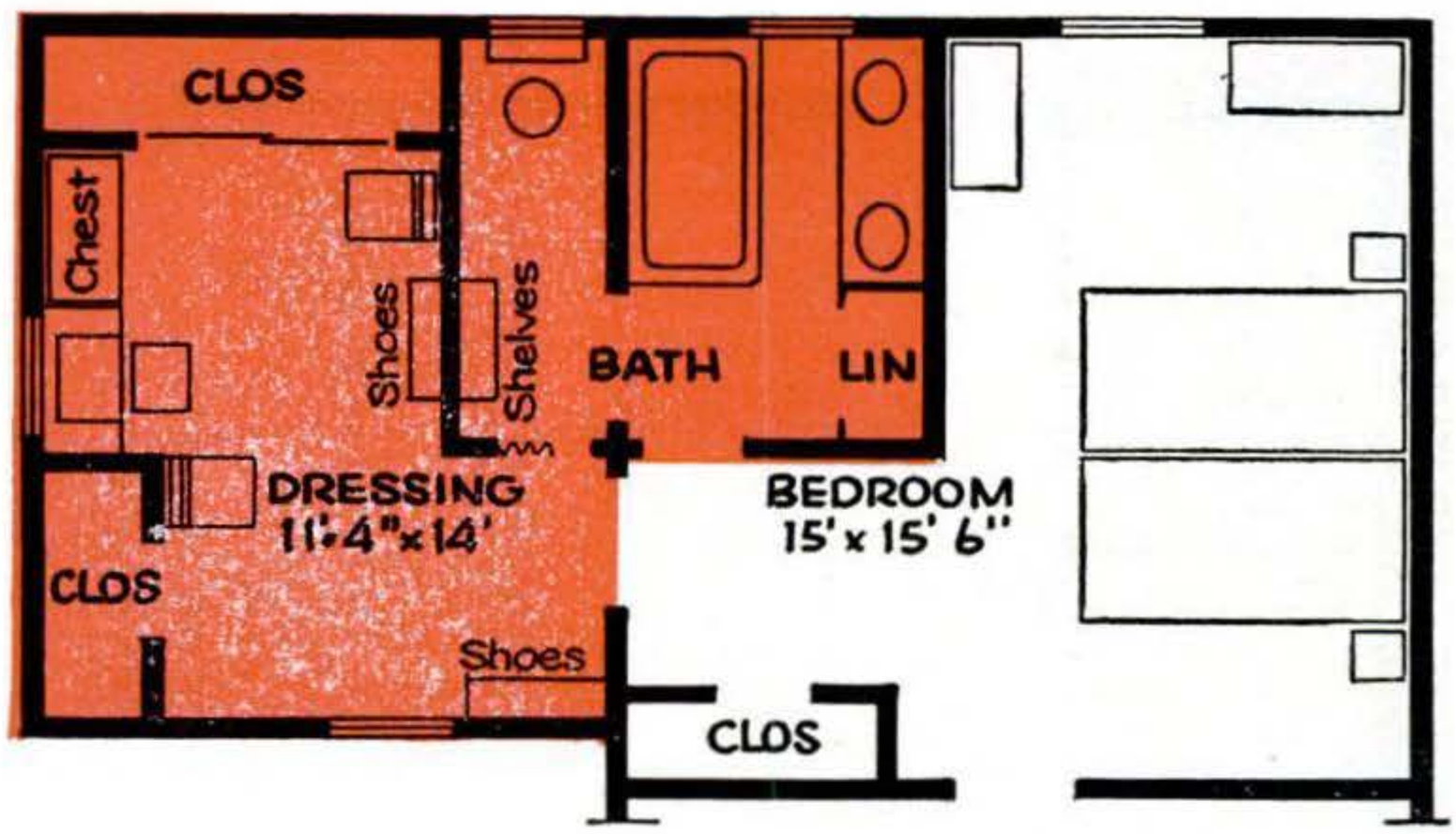

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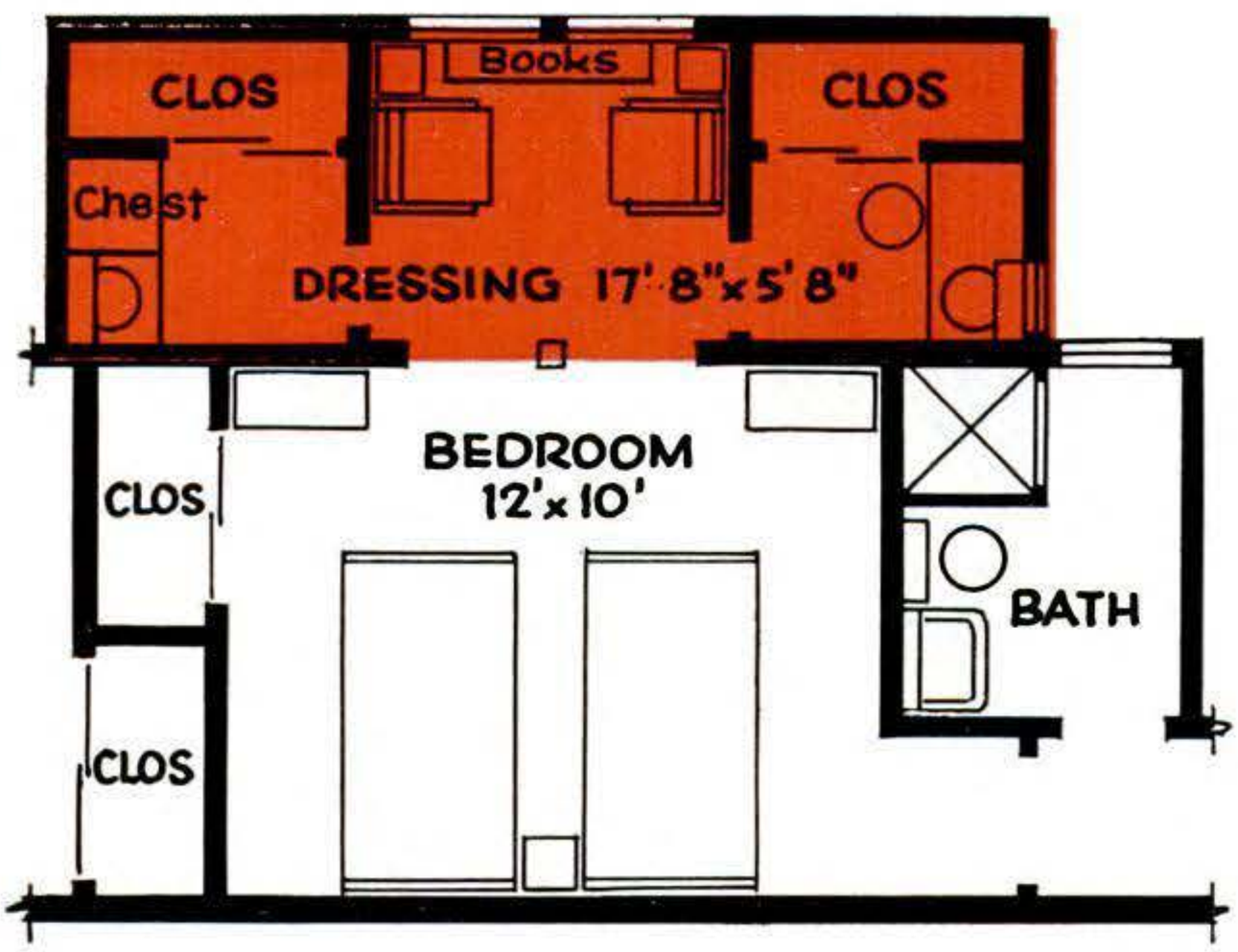
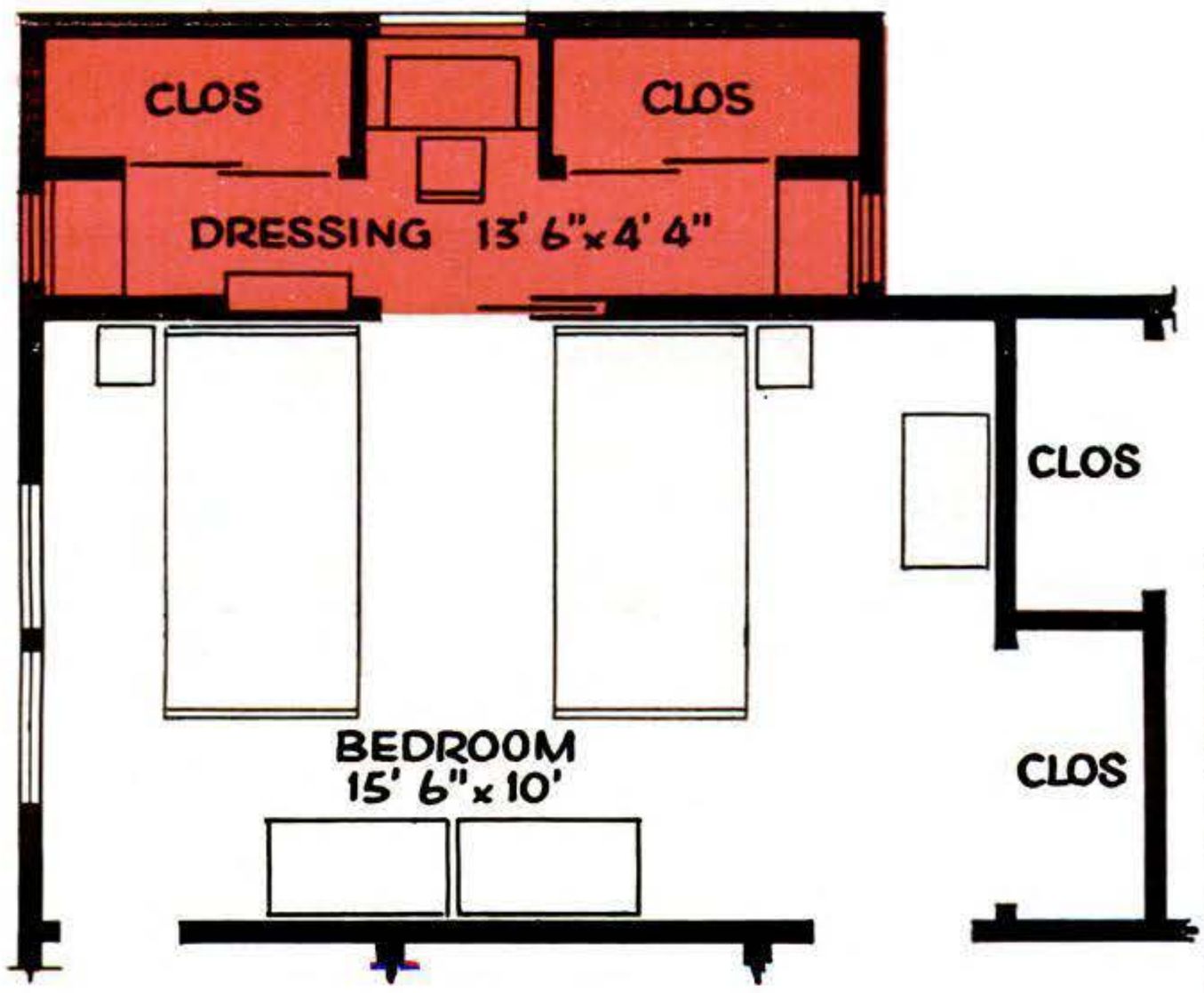


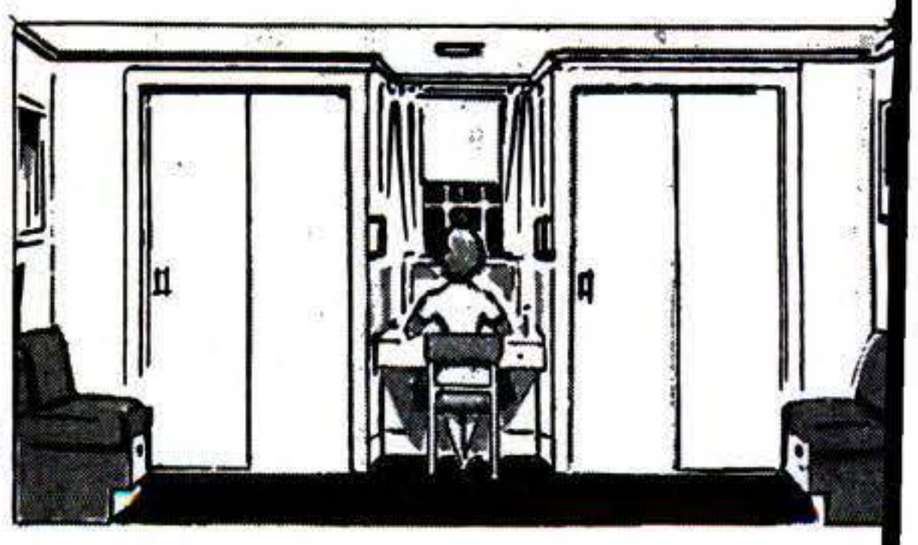
Privacy, comfort in small space

Cramped quarters? No quiet spot for relaxing? An 8′-by-18′ addition solves both problems here. Equal-size dressing rooms flank a sitting room for reading or talk. A double window in the bedroom became a wide-opening arch and the window was reset in the sitting-room space. The roof is a sloping shed type with two-by-six rafters. The bedroom hardwood flooring was continued into the addition. Both dressing rooms have washbowls with cabinets above, and sliding-door closets. Bifold or slatted doors close them off from the sitting nook.

Separate but equal dressing and closet space makes for family harmony



Here's a share-alike addition except that "she" gets a bonus—a vanity in between. A bedroom window became a door, and the window was reset between new closets. One sliding door on the wife's closet is a full-length mirror. The door to the bedroom could be sliding or bifold. A ceiling height of 7′ 2″ in the 65-square-foot addition allows for a shingled, pitched roof.



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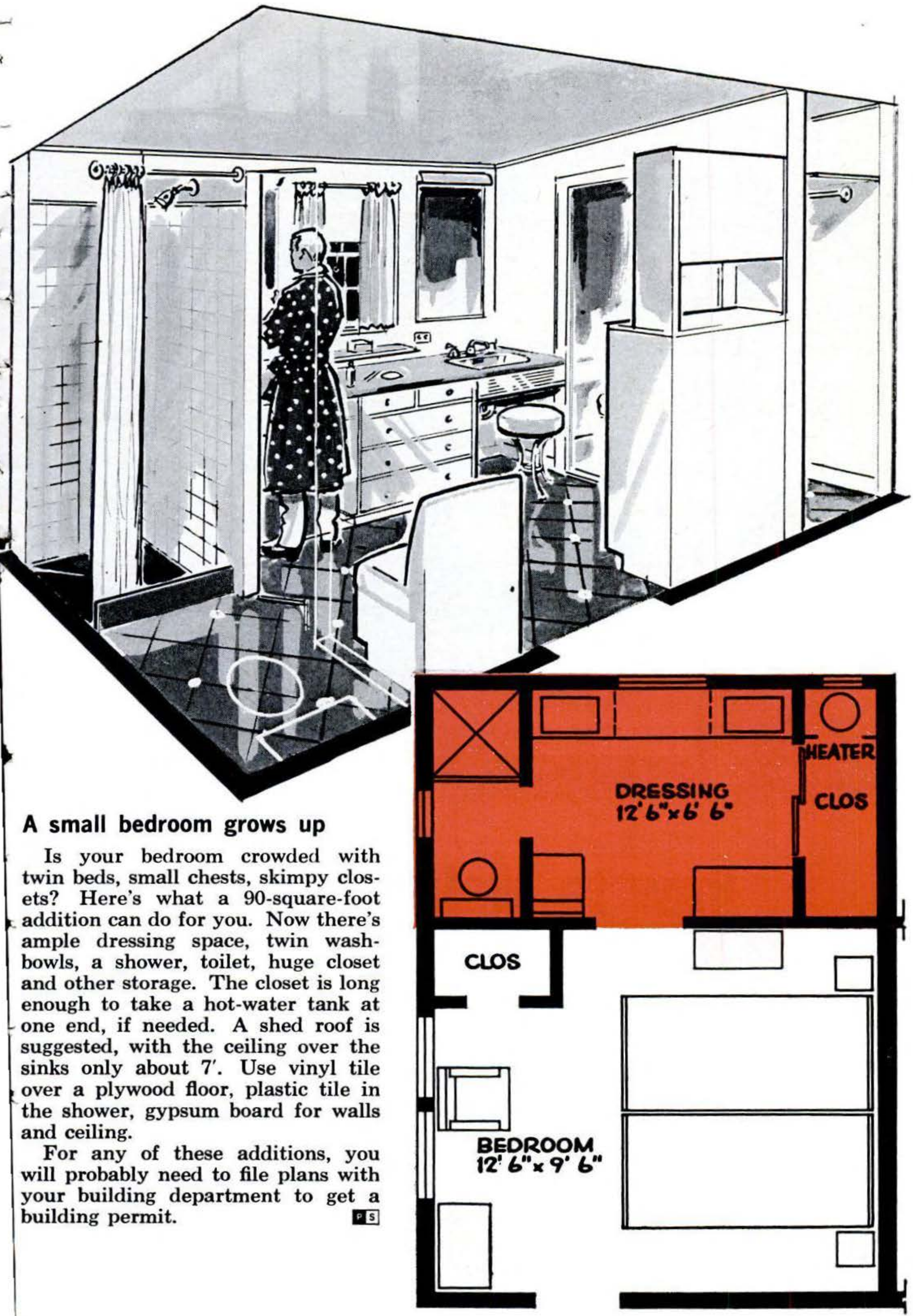

A small bedroom grows up

Is your bedroom crowded with twin beds, small chests, skimpy closets? Here's what a 90-square-foot addition can do for you. Now there's ample dressing space, twin washbowls, a shower, toilet, huge closet and other storage. The closet is long enough to take a hot-water tank at one end, if needed. A shed roof is suggested, with the ceiling over the sinks only about 7′. Use vinyl tile over a plywood floor, plastic tile in the shower, gypsum board for walls and ceiling.

For any of these additions, you will probably need to file plans with your building department to get a building permit. PS

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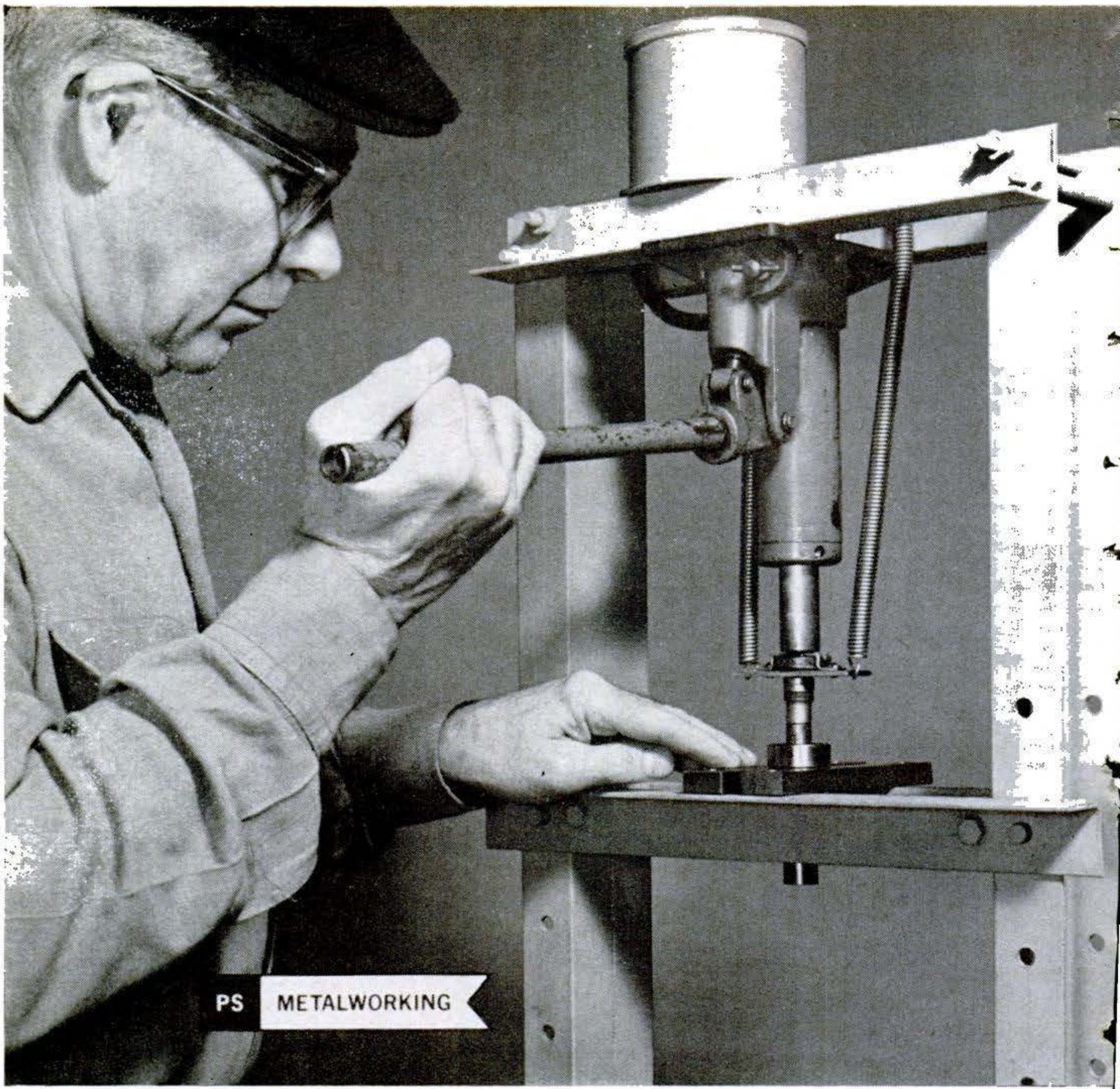

How to Make an Arbor Press

A luxury tool for the home shop? Not when you build one that makes extra use of a hydraulic auto jack

By FRANK L. GREENWALD

An arbor press is one of those tools you're not sure you need—until you have one, and then you wonder how you managed without it. It's ideal for making light press fits, as when installing bearings or bushings; for straightening bowed shafts, bolts, or pins; for broaching small keyways through th centerholes in gears and pulleys; and fo light metalwork assemblies, such a crimping lugs to clamp parts together.

The rail-type work rest of the pres shown also lets you remove bearings b pushing them through; if you do an metal turning, this feature also make quick work of the installation and re moval of tapered arbors. And you don

Continue

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SCREEN-DOOR SPRING CUT IN HALF FOR 2 PCS.

5/16"-18 x 4" BOLT WITH LOCK WASHER AND NUT (8 REQ.)

1/8" x 1 1/4" STRAP IRON 26" LONG (2 REQ.)

14"

OIL RESERVOIR 1/2-OR 1-POUND COFFEE CAN

1/4" PIPE CUT TO FIT (4 REQ.)

ALL ANGLE IRON 1/8" x 1 1/2" x 1 1/2"

SOLDER COMPRESSION SLEEVE EL: 1/8" PIPE WITH REDUCER

1 1/2-TON HYDRAULIC JACK

26"

1/4" x 1" COPPER TUBING

3/8" DIA.- 5 HOLES EACH SIDE 2 1/2" O.C.

1/4" NEOPRENE OR PLASTIC TUBING

5/16"-24 BOLT- REWORK AS SHOWN

3/8" DIA. 5/16" DIA. 3/4" 1 3/4" 1"

5/32" DIA. 1/4" DIA. x 5/32"

1/4" x 1" COPPER TUBING SOLDER IN PLACE

5/16"

CONNECTOR

3"

3/4"

2 1/2"

4 1/2"

1 1/4"

1/4" DIA.

3/8" x 4" ROD (2 REQ.)

1/4" x 3 3/8" PIPE WITH 5/16"-18 x 4" BOLT (2 REQ. OF EACH)

CLIPS: 1/16" x 1" STEEL STRAP SHAPED TO FIT JACK PAD

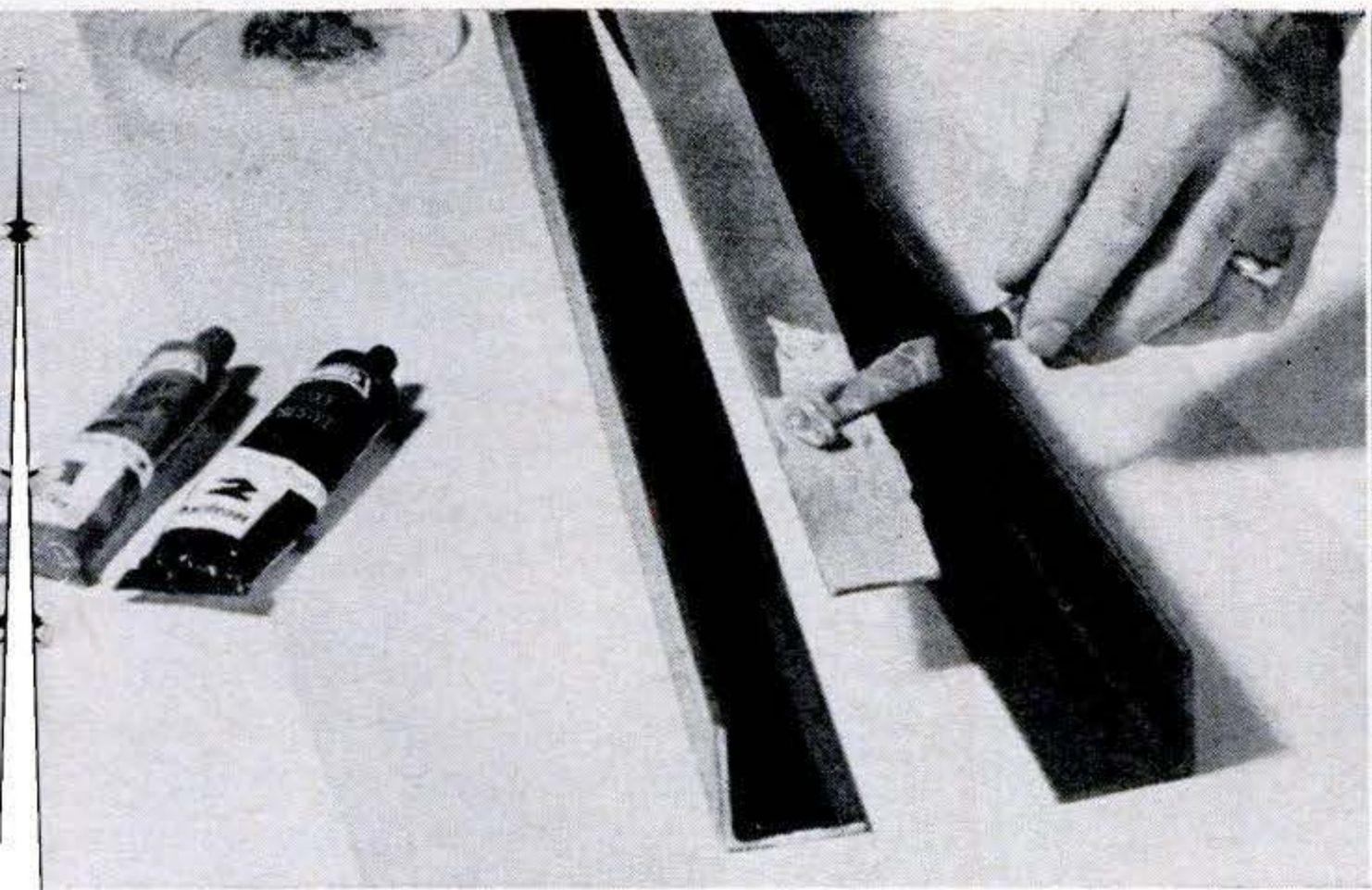
DRILL & TAP FOR 3/16" STOVE BOLTS

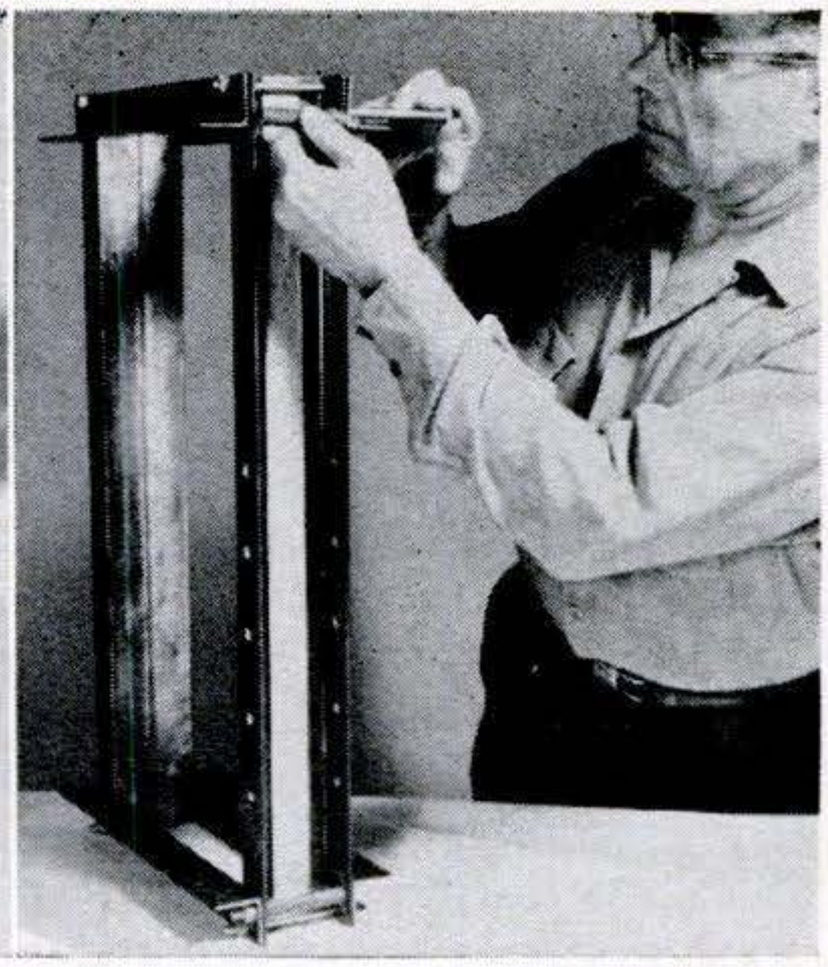
1/8"

SPRING ANCHOR AND PRESSURE PAD

ADJUSTABLE WORK REST 16" LONG (2 REQ.)

1/2" 3/8" 1" 3/8"





Avoid welding by cementing bar stock and angle into channel beams. Wipe surfaces with naphtha-wet rag, then butter bar with epoxy mix and press in place with slight gap between angles. Force gap shut.

Insert corner bolts through pipe spacers to take clamping pressure and prevent distortion of frame. To locate holes in channel, use each drilled cross-piece as template, making pilot hole with 1/8" bit.

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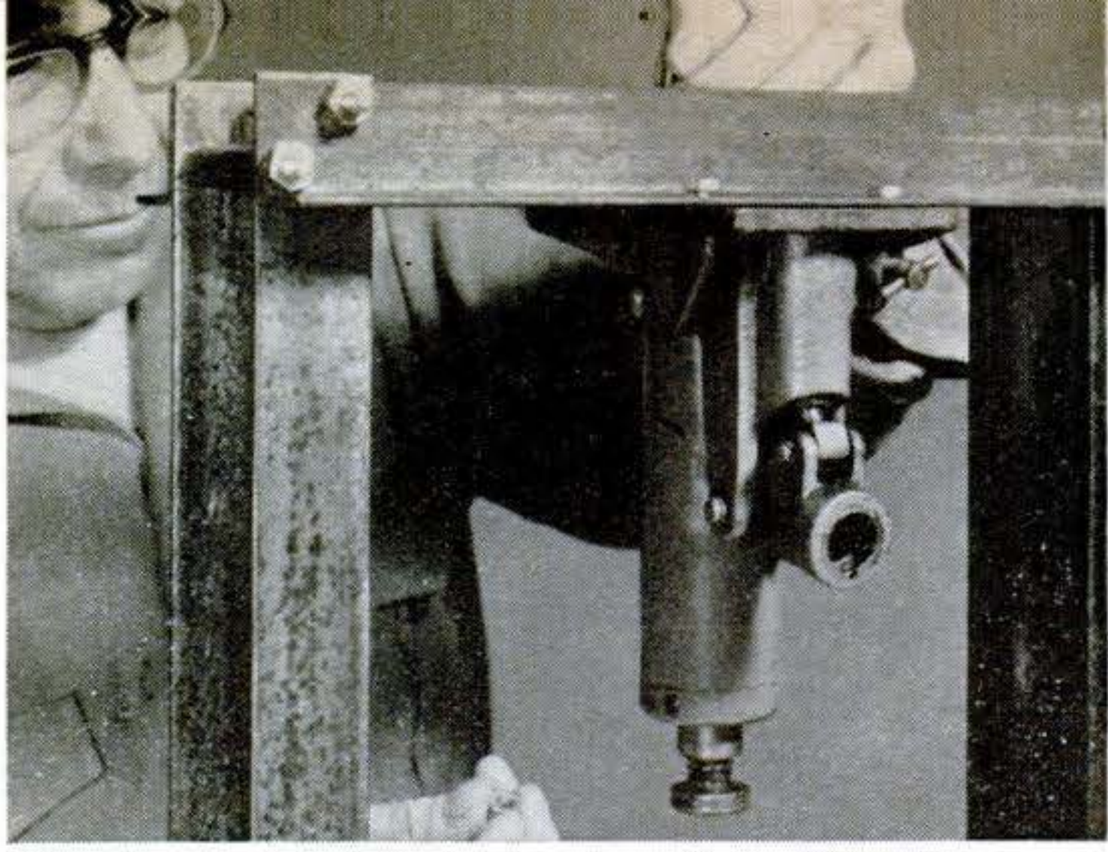
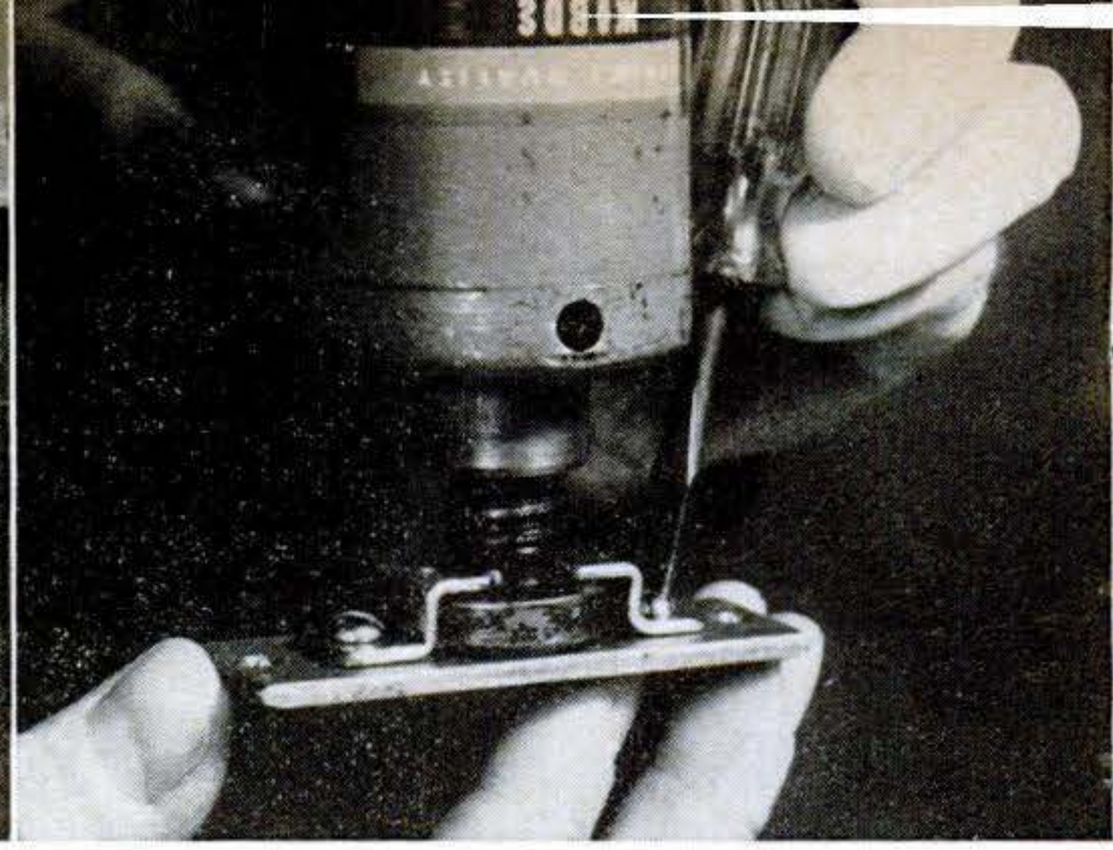
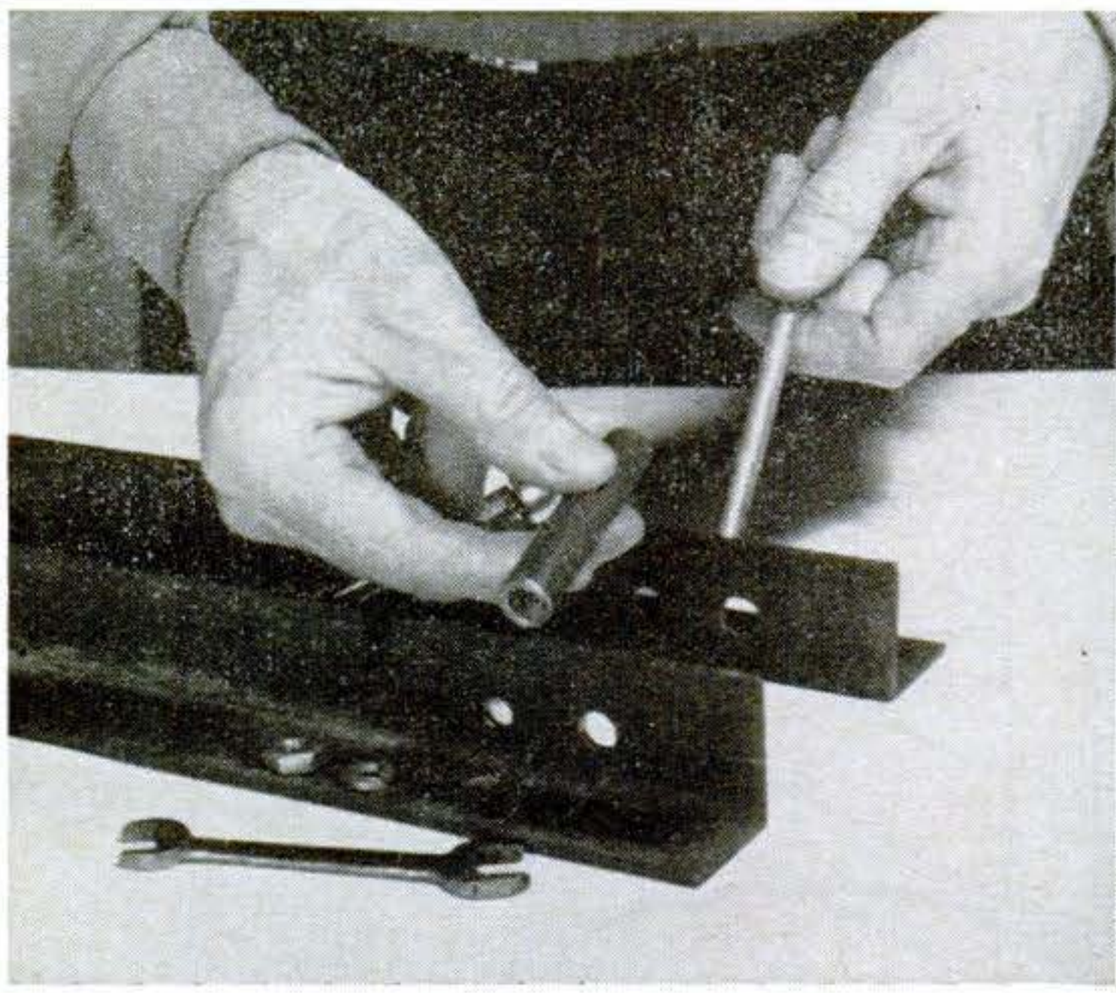


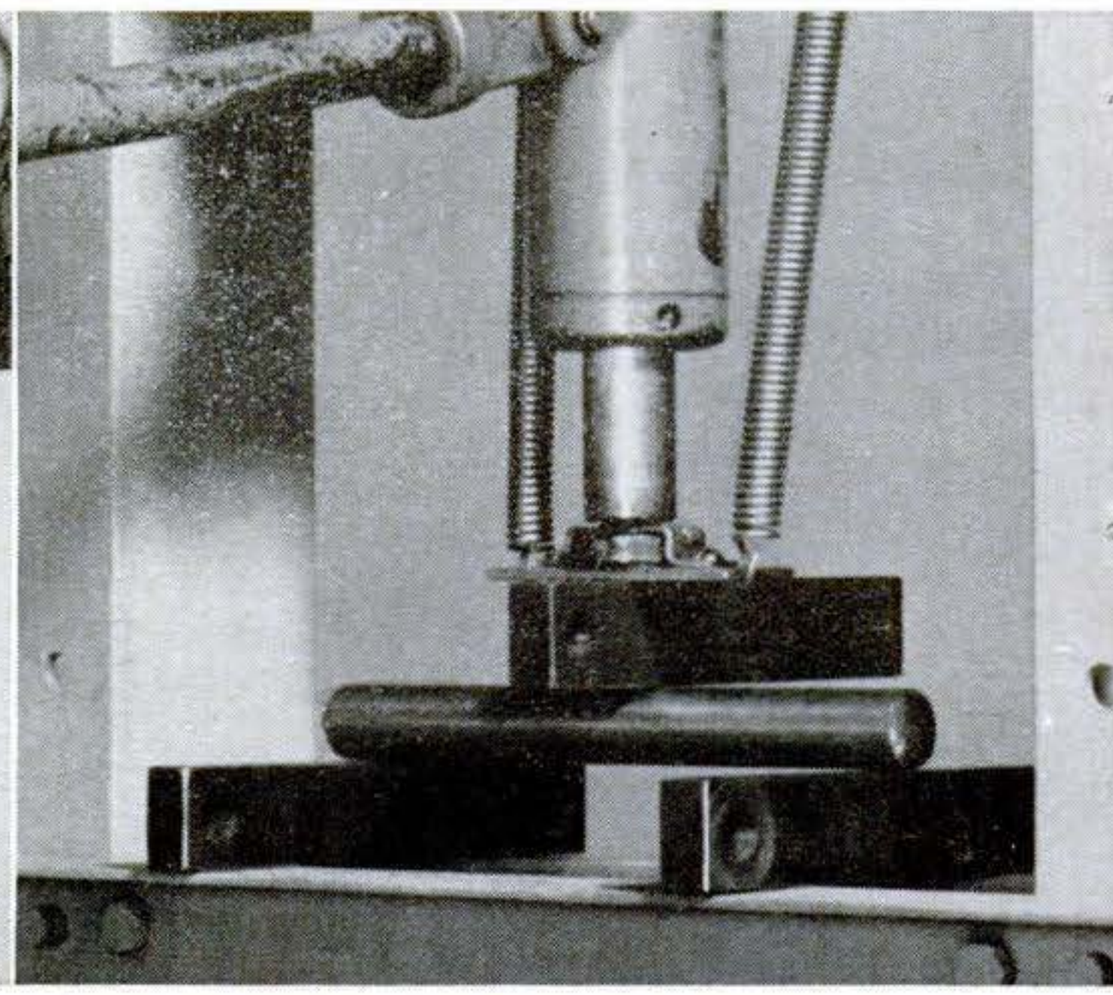
Attach jack at top of frame so it can be easily removed. Method depends on jack base; most can be drilled and tapped. Here, two bolts anchor one end; single hook bolt passes through holes and into nut.



Pressure plate covers patterned jack pad unsuited for pressing jobs, also provides means for attaching retracting springs. Tap inner holes for bolts through Z clips; backing off bolts lets you remove the plate.



Work rest is assembled with bolts through pipe spacers that fit within channel frame. Outer holes are reamed to offer free fit for 3/8" locating pins that pass through channel flanges to adjust height.



Bar-stock scraps can bridge the gap in the work rest for jobs such as straightening arbors or shafts. A third scrap, held at right angles to pressure plate with fingers at start, exerts centered pressure.

need a lot of accessories: Wrench sockets and scraps of bar stock serve as adapters.

You'll think of additional uses once you work with the press. And the nice thing about building one around a detachable 1½-ton hydraulic auto jack is that you won't have a big investment tied up in an occasional-use tool.

I made my frame from 1½"-by-1½" angle iron, cemented (with epoxy) and bolted to avoid welding. If you own a welder, use it instead. The sketch and photos detail the construction. Invert the assembled frame and position the jack on the top rails so as to center its ram between the channel beams, in line with their center seams. Bolt it in place.

To use the jack upside down, you'll need a simple reservoir mounted above it. I used a ½-pound coffee can; the kind with a plastic lid is best, since the lid is flexible enough to compensate for fluid-level changes without a vent hole. If you don't have the compression sleeve shown in the sketch, just solder a straight piece of tubing into the bottom of the can. Replace the filler plug of your jack with a connector made to fit (see detail). Use the old gasket (or replace it if it's deteriorated) and save the plug for future use. Connect the reservoir and the jack with a length of neoprene or plastic tubing (not natural rubber); if the tubing fits snugly, it needn't be clamped. Pour into the reservoir about four ounces of hydraulic, refrigerator, or light-bodied motor oil. If necessary, work the pump until air is replaced by oil. PS

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New Incinerators Burn the Smoke, Too

You can install one of these gas-burning appliances under a kitchen counter. Air pollution? None

By A. M. WATKINS

On a bitter-cold winter night, Jack Landry heard his wife say for the third time that week, "The garbage is overflowing, dear. Please take it out." He got up and got rid of the garbage, but decided, then and there, to do something about it.

Next day he bought one of the compact new smokeless and odorless incinerators that you can install in the back yard, basement, garage, utility room, or under the kitchen counter. He bought it for four reasons:

- Because he was fed up with having

Continued

Undercounter model fits in space 15" wide and can be vented through the outside wall since it, like all the new incinerators, is smokeless and odorless. Magic Chef, Cleveland, Tenn. 37211, makes it.

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Typical incinerator for use in basement, garage, or utility room is shown at left. To install one, you need a gas connection and a suitable chimney to vent it.

A special decorative cover for outdoor installations of Warm Morning incinerators is by Locke Stove, Kansas City, Mo. 64105. The cover has a built-in chimney.

to take out garbage and trash in cold weather.

- Because he was fed up with cleaning up when stray dogs overturned his cans.
- Because the local garbage and trash pickup service was inadequate.
- Because, come spring, he no longer could burn accumulated house trash outdoors as a result of a stiff new antipollution law passed by his town.

News about these new smokeless and odorless household incinerators is particularly timely now because of a growing concern about air pollution.

Many suburbs and cities—Cleveland, Detroit, Milwaukee, and Pittsburgh among them—have passed antipollution laws. At least eight states have also passed laws that ban burning that puts smoke and odors into the atmosphere. The new incinerators are generally permitted in communities with such laws, but you should check.

What they are. The new incinerators, smaller than dishwashers and clothes dryers, will burn 75 to 80 percent of the trash and garbage (wet or dry) in the average home. You can dump in paper, bones, sweepings, wet and dry garbage, and it will all burn down to a fine white ash, without smoke or odors going up the chimney. By comparison, a household sink disposer gets rid of only about 15 percent of household garbage.

Glass and metal, of course, will not burn. That usually amounts to not more than 20 or 25 percent of the average household's waste.

Introduced some 10 years ago, the smokeless and odorless incinerators are now available in new models.

How they work. Key to the no-smoke and odorless operation is a second stage—or afterburner. Old-style home incinerators came with only one burner and one combustion chamber. Inevitably some refuse was not fully burned and went up the chimney.

A new unit burns its own smoke. That's where the afterburners come in. Any unburned particles that get past the first set of flames are completely consumed by the afterburners. It's the same principle of 100-percent combustion used on big two-stage municipal incinerators.

The new incinerators will handle a load of garbage and trash of from 1½ to two bushels. Sizes average around 22 inches square—some are smaller—and from 30 to 36 inches high. Like household water heaters and other gas appliances, they come with an automatic valve that turns off the gas if the pilot light goes out.

Though they get hot, there's no danger of a child or pet brushing against one and getting a skin burn; heavy jacket insulation is used. In addition, most models have a door lock. This means that once the unit is turned on the door can't be opened until the load inside has burned. As for service and maintenance, virtually the only small chore required

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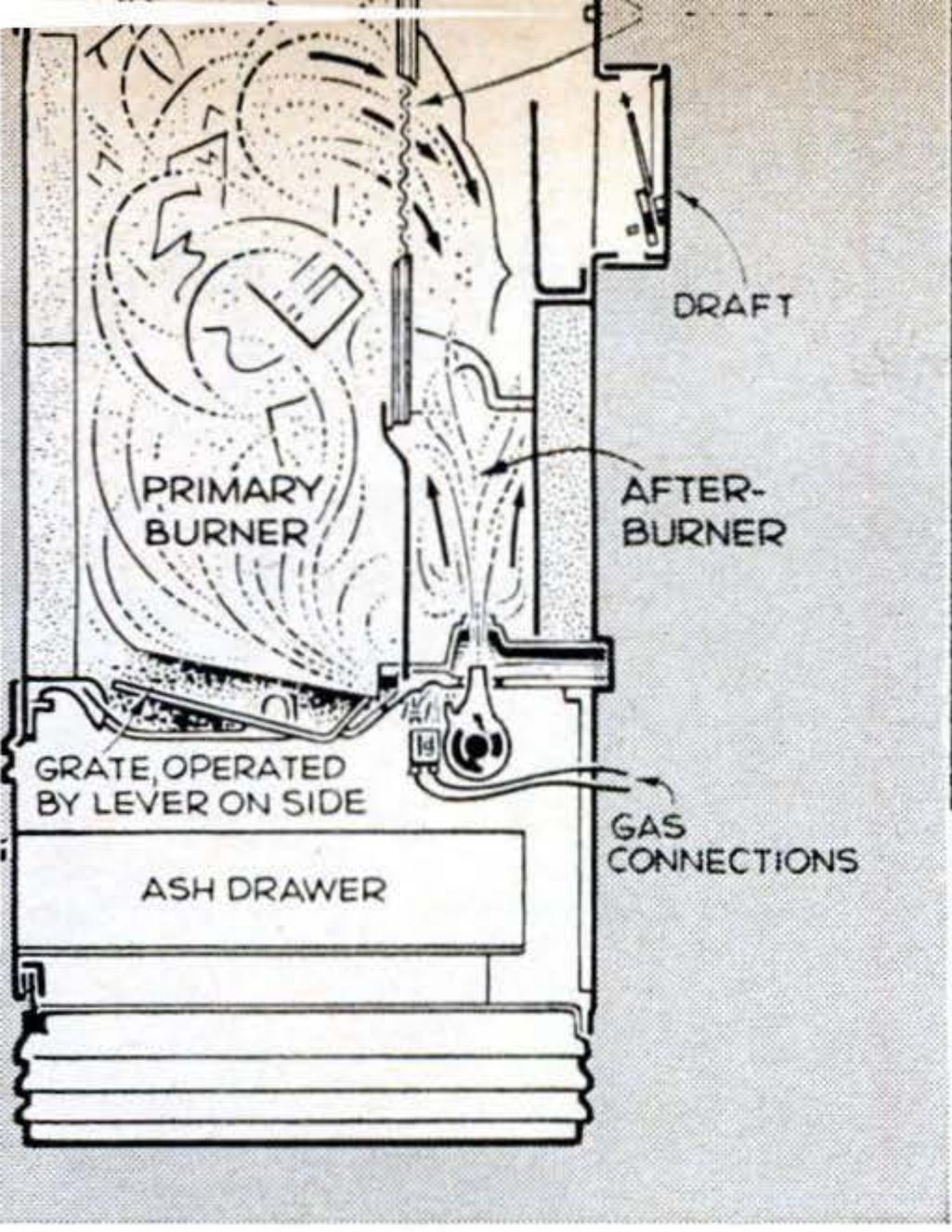


An afterburner is the key to operation of new smokeless, odorless incinerators

Place a lighted match in the smoke from a cigarette and you can see the principle of operation of the new incinerators. The rising smoke is burned by the match flame. In the same manner, smoke and odors from the primary combustion in an incinerator (see sketch at left) are burned in afterburner.

is emptying the ash about once every week or two, depending on how often you use your unit. (Dump it in your garden; it's a fine mulch.)

The units operate on any kind of gas—manufactured, natural, or bottled.

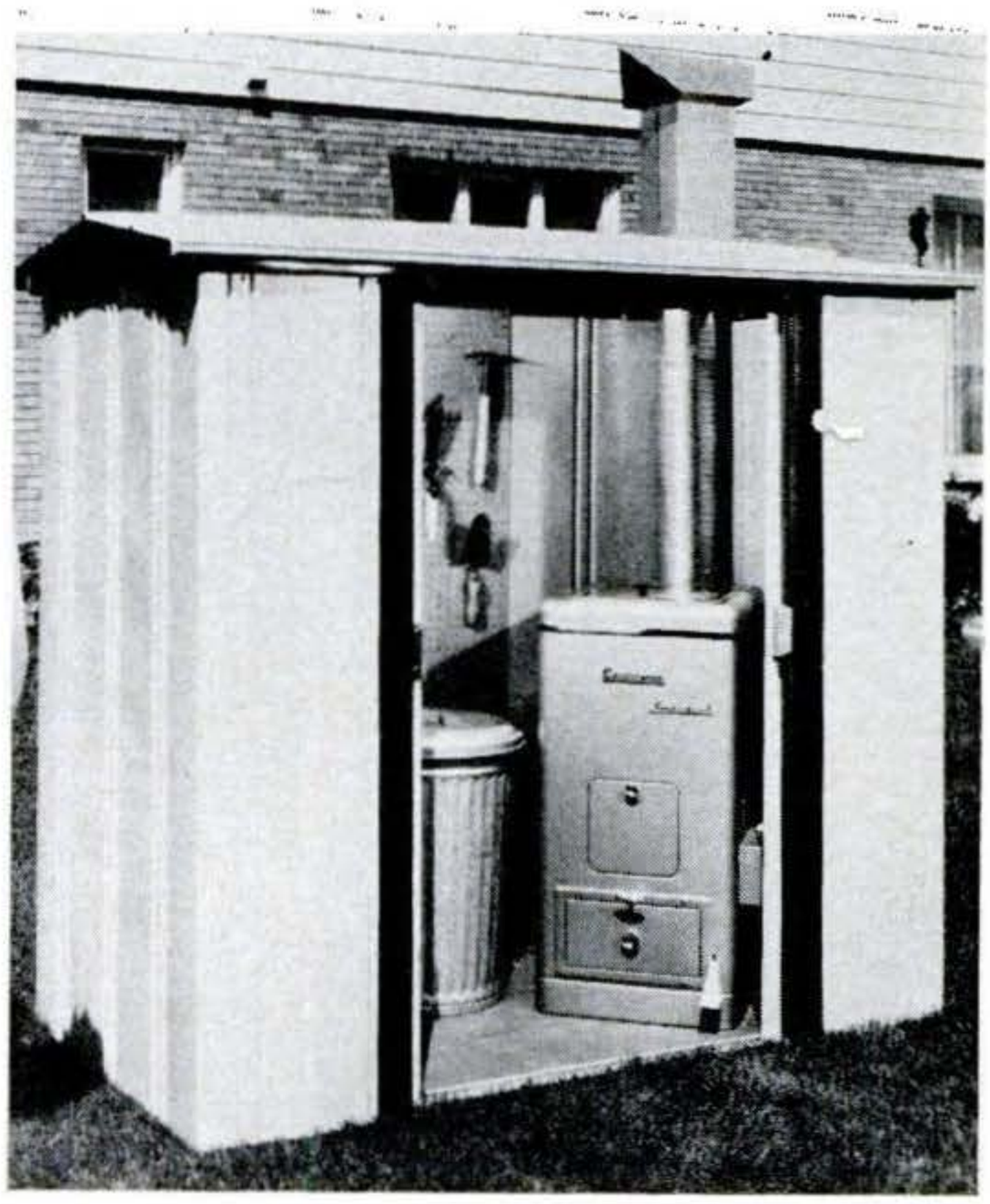
Prices. Average price is $165, according to a survey of the units sold by more than 40 gas utilities. Some come as low as $125; others are over $200, again depending on the size and model desired. Operating cost averages between $2 and $3 a month, based on once-a-day use.

Sometimes the cost of installation is tossed in free; more often it will run about $20 to $35. That's the cost of the two hookups required, a line for the gas supply, and a vent to your chimney.

You'll need a Class A or Class L chimney. You can hook in an incinerator even if your furnace and water heater are also connected to the same chimney. Most chimneys, particularly in the North and Midwest, are the tough, high heat-resistant Class A kind. That includes the insulated double-wall kind of prefabricated metal or ceramic. Chances are you have the right chimney if you have central heat or if you have a fireplace.

There are also Class B chimneys, a lower-cost type found chiefly in the South and West. These won't take the heat of an incinerator unit. If you have one or no chimney at all, you'll need a new Class A vent. This usually can be provided by a factory-built, double-wall, insulated chimney for $50 to $60 installed.

The new incinerators are sold by such companies as Bastian-Morley, Calcinator, Dornbach, Locke Stove (Warm Morning), Majestic, Martin Stamping, E. L. Mustee (Duramatic), and mail-order houses like Sears, Roebuck. To be sure you get an approved smokeless and odorless model, look for the Blue Star emblem of the AGA (American Gas Association) on the unit. PS



Garden shed to house incinerator (and garden tools) is made by Calcinator, 1601 Water, Bay City, Mich.

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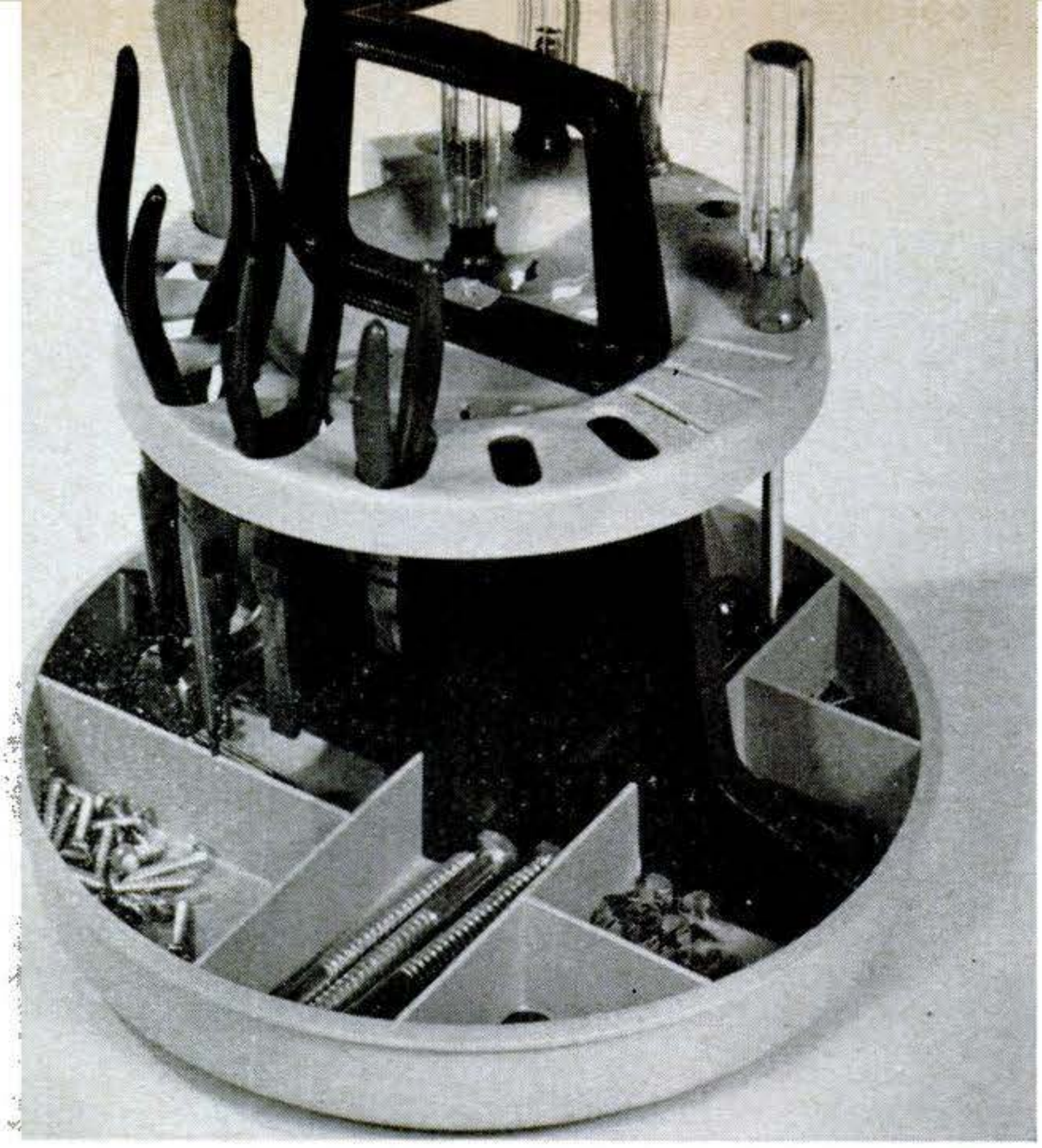

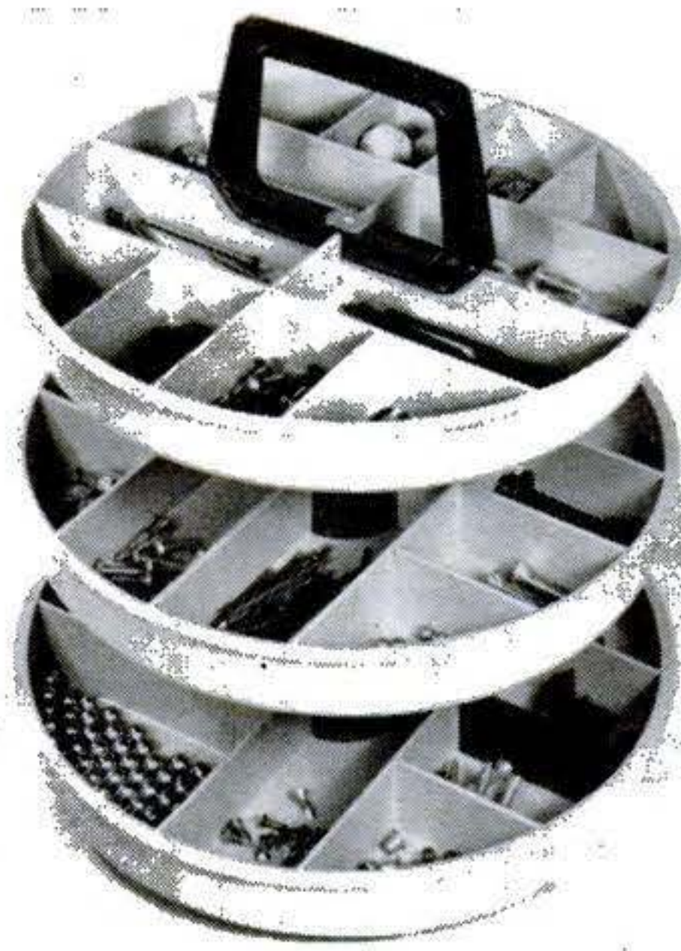

Two revolving storage accessories keep tools and hardware organized on the workbench in a neat, ready-to-go carrier for household repair jobs. The Tool Caddy (left, $3.98) holds the most frequently used tools on top; the base tray is divided to hold screws, nails, and small items. Triple-decker Parts Caddy ($4.98) has 34 compartments, which let the user tote a large variety of hardware to the job in one trip. Rubbermaid, Wooster, Ohio, manufactures both units and sells them through hardware stores.

Pin Boy 66 offers a fast, safe method of fastening things to masonry, concrete, or soft metal. Insert the fastener in the bottom opening, position the point on the desired spot, and strike the plunger with a hammer. $2.95. Remington Arms, Park Forest, Ill.

Trig-R-Trol Torch has an adjustable pilot light that becomes an operating flame when the trigger is squeezed—reverts to pilot flame when it's released. Both flames are adjusted separately. $12.50. Turner Corp., Sycamore, Ill. 60178.

Versatile saber saw tilts up to 45 degrees in either direction. A motor fan blows air directly into cutting line, keeping it free of sawdust. The blade-changing wrench is always at hand—it's stored in the friction recess. $23.88. Millers Falls, Greenfield, Mass.

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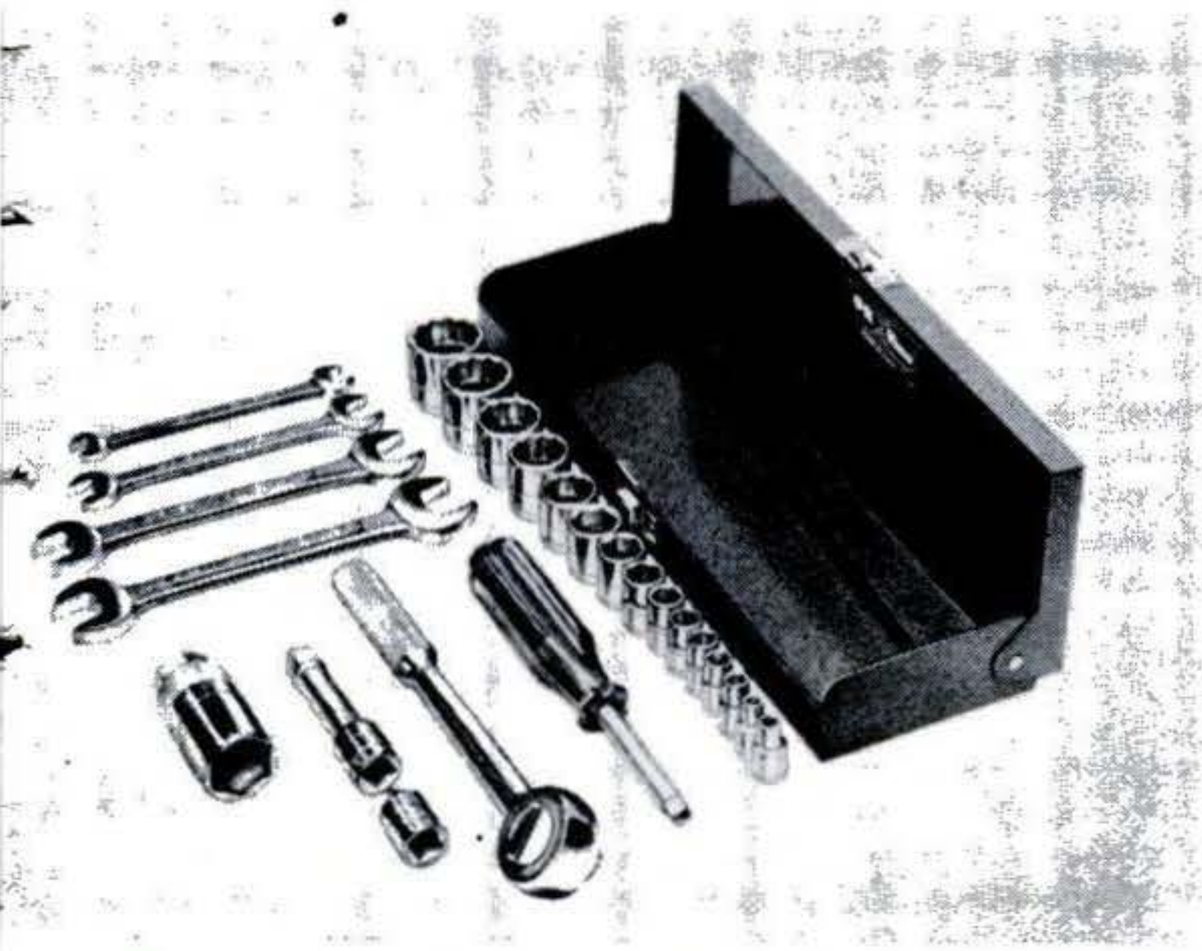
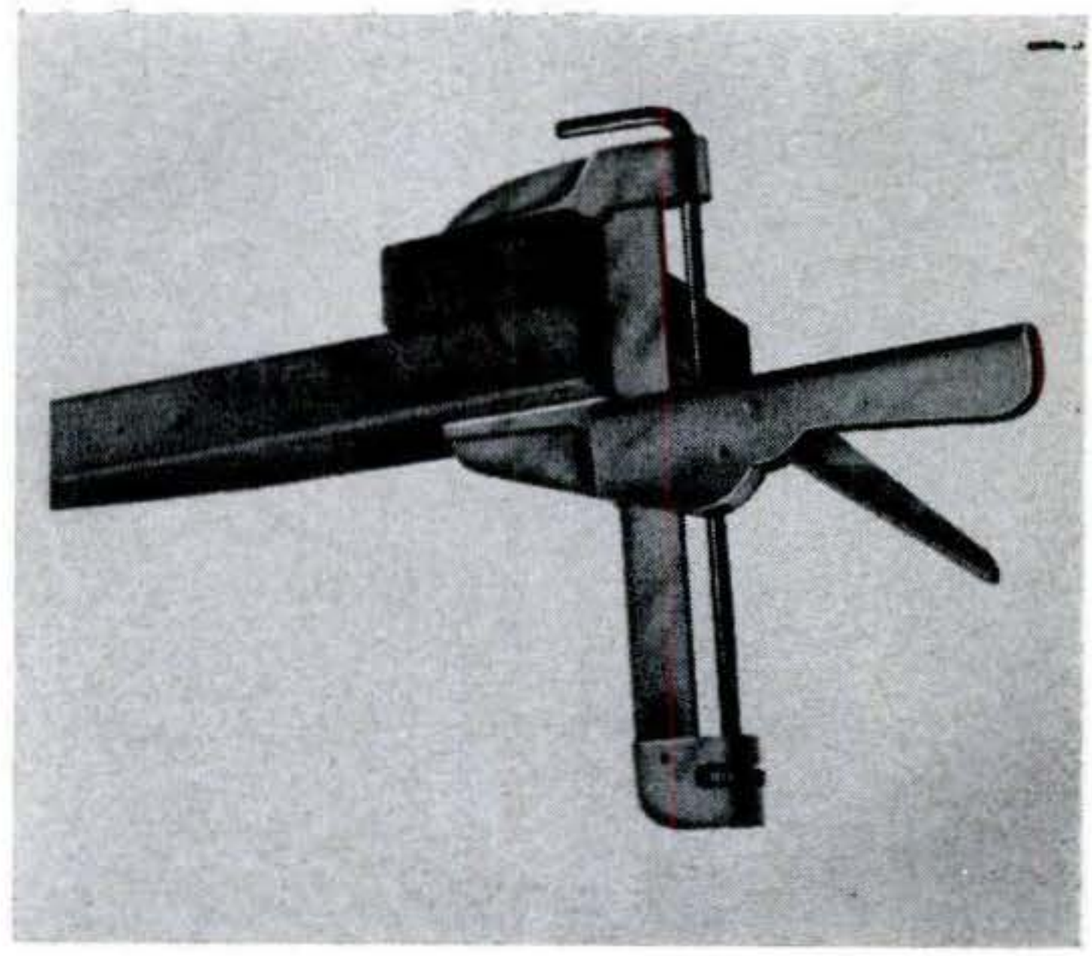
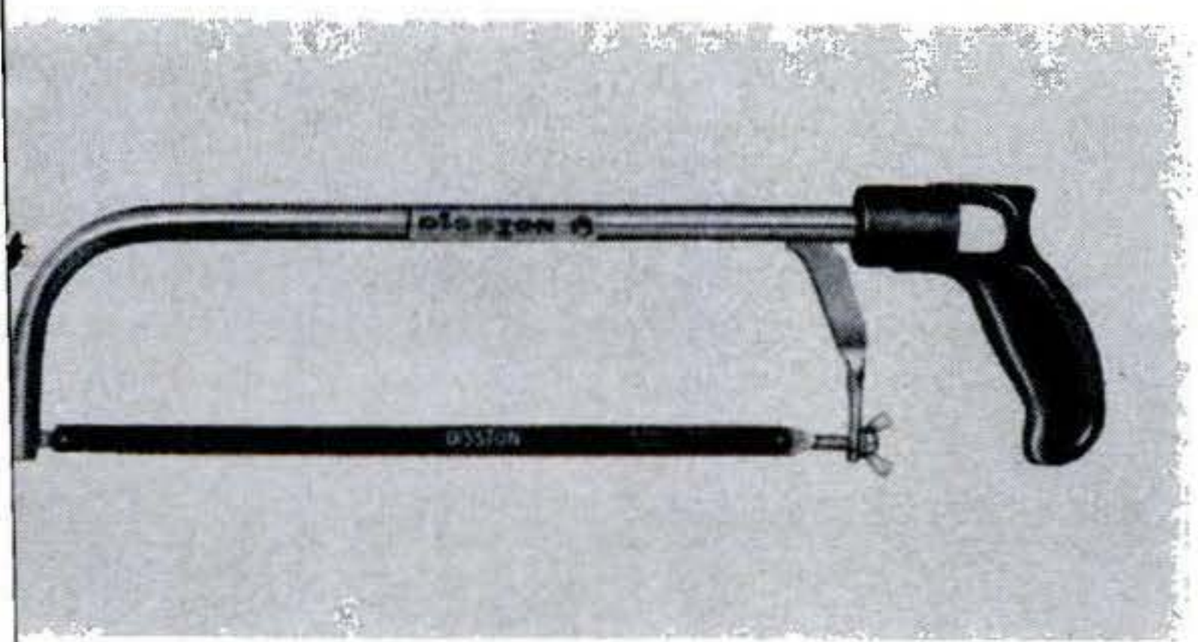
New in Tools



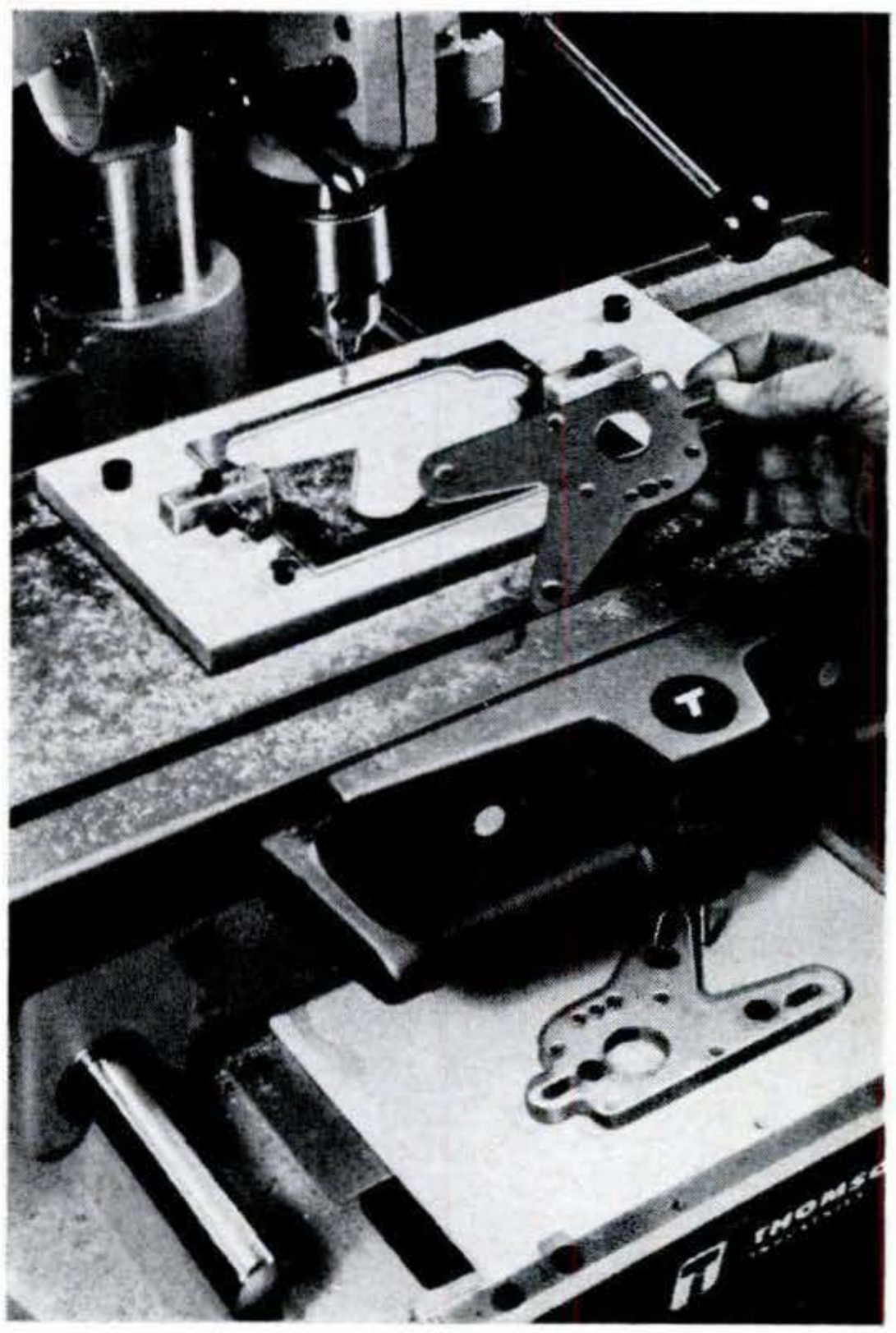
Twenty-four-piece socket set is priced to save the user $9.21 (over regular cost of all components), claims its maker, S-K Wayne, 332 S. Michigan Ave., Chicago 60604. Set consists of ¼″ and ⅜″ drive sockets, handles, and four wrenches in a metal case. $17.95.



One-hand clamping is possible with Versaclamp—it's pumped like a caulking gun. Four jaws are available, including a pipe-holding V jaw and a thin one for hard-to-reach places. $10.95. Thane, Bldg. 19, Lincoln Air Park West, Lincoln, Nebr.



First tubular hacksaw frame in the Disston line has been introduced by H. K. Porter. Constructed of chrome-plated tubular steel, the lightweight frame takes either 10″ or 12″ blades. Frame, which comes complete with Disston blade, sells for $2.95.



Something to dream about in drill-press accessories is the T/C Mill Drill. It's a hand-operated, work-positioning table for production- and contour-milling operations. Table movement and position are controlled by a hardboard template. Mounted on a simple drill press (right), it did all the drilling and contour work on the piece held by the operator, following the template in the foreground. Thomson Industries, Manhasset, N.Y. 11030. Cost of the unit is $980.

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A GOOD WINTER CHORE:

Repairing

New line guides will work wonders on a favorite piece of equipment. Here's how to install them and make other repairs

By A. J. HAND

After a few seasons of hard fishing a rod shows wear. Enamel chips off, guides get bent, corrosion freezes ferrules, windings come loose, the cork handle disintegrates. It's a good idea to check such things before you get a big one on—and he gets away because your equipment wasn't up to snuff.

First, the guides. Cheap guides are plated and plating may flake off in sharp little slivers that can knife your line. Guides made of soft metals wear from line friction—especially the tip guide. Worn guides are hard on lines; replace them.

Replacements are sold singly or in sets. If you can't find one to match the others on the rod, use the closest match you can find. Or replace the whole set. And avoid the plated guides and those made of soft metal. Agate-lined guides wear best, but the agate may chip, leaving a sharp edge that can cut the line. Good all-metal guides are your safest buy. Even though you replace only one or two, it's best to rewind all the guides, and the ferrule, too.

The winding rack shown makes the job quick and

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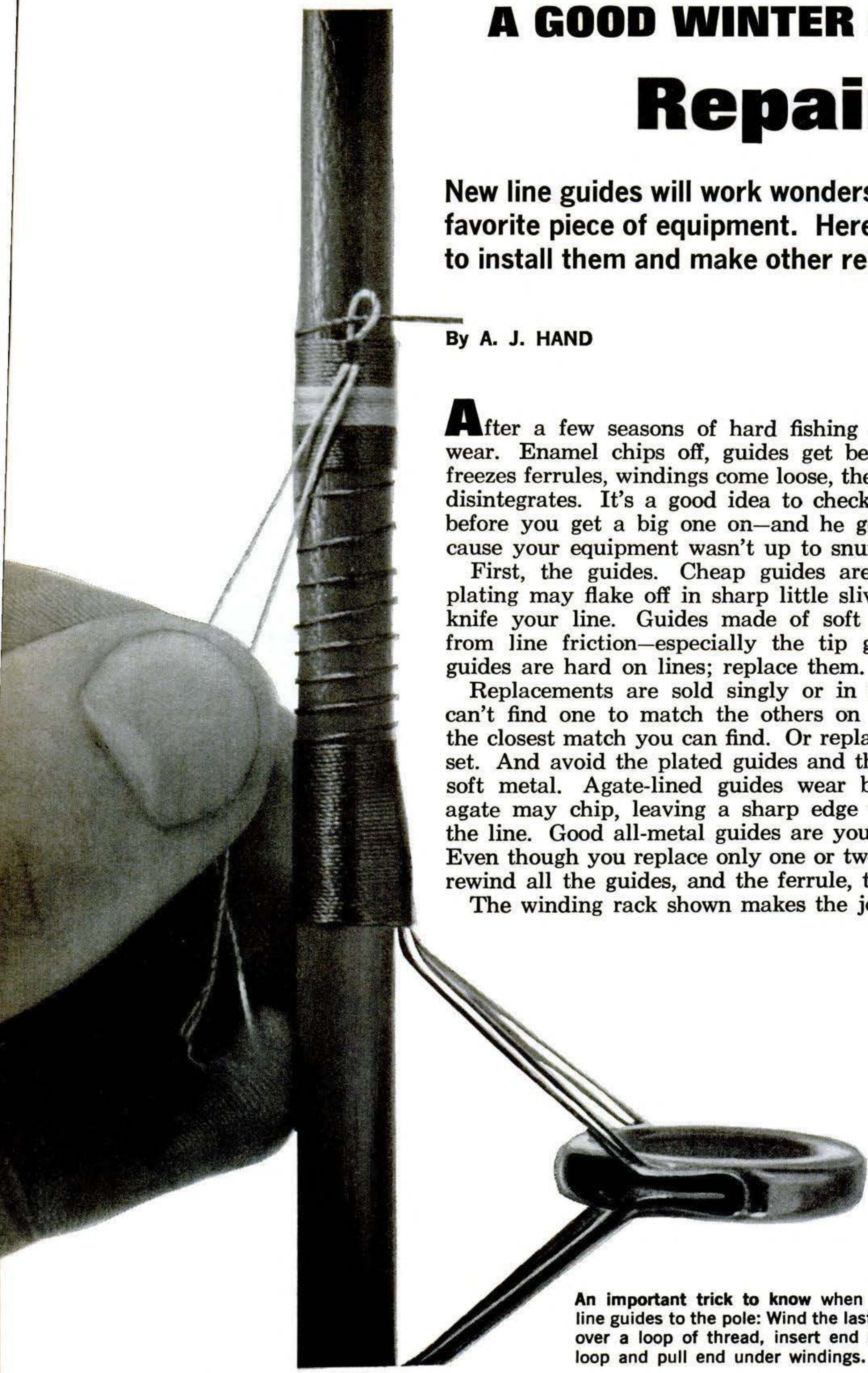

An important trick to know when you attach new line guides to the pole: Wind the last five or six turns over a loop of thread, insert end of wrap through loop and pull end under windings. Cut off excess.

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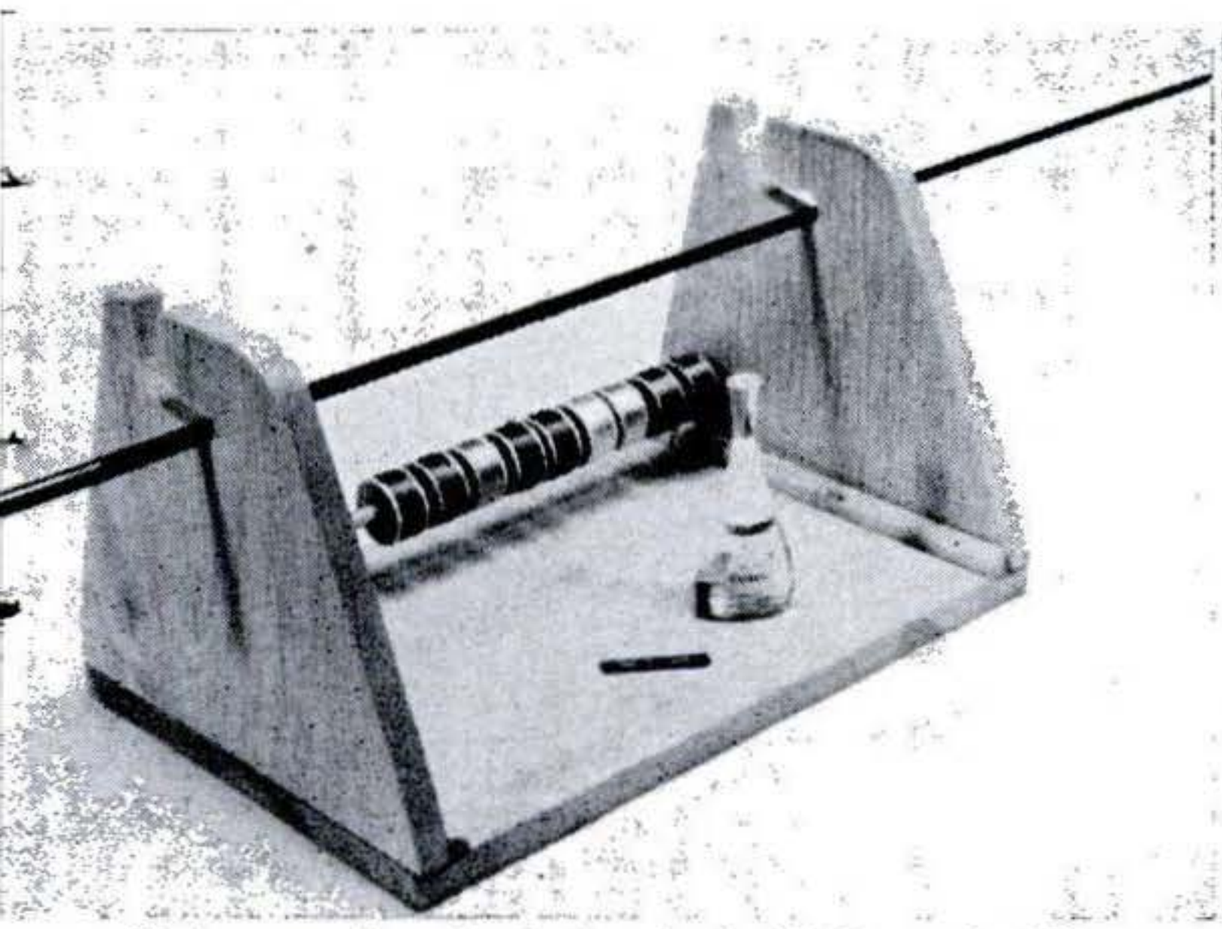
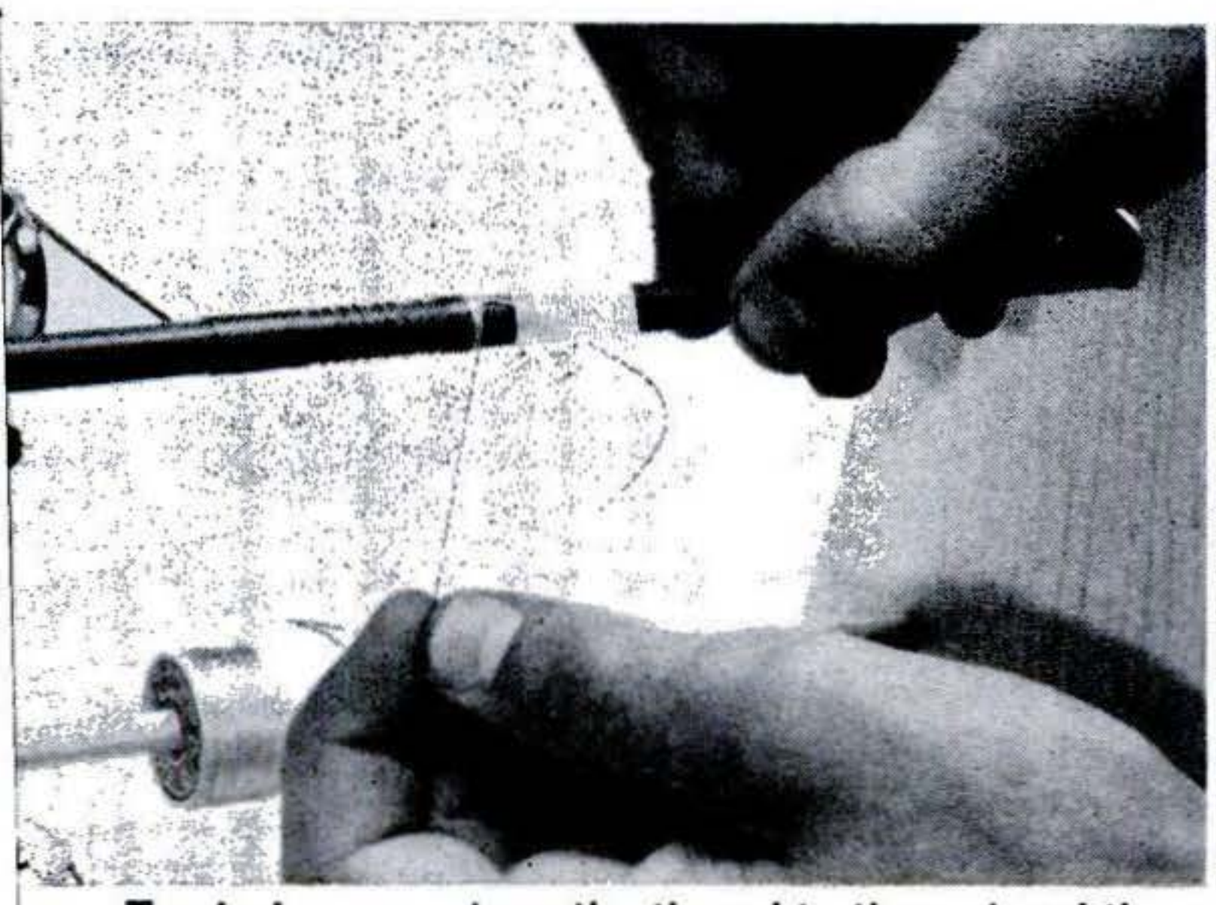
Your Fishing Rod

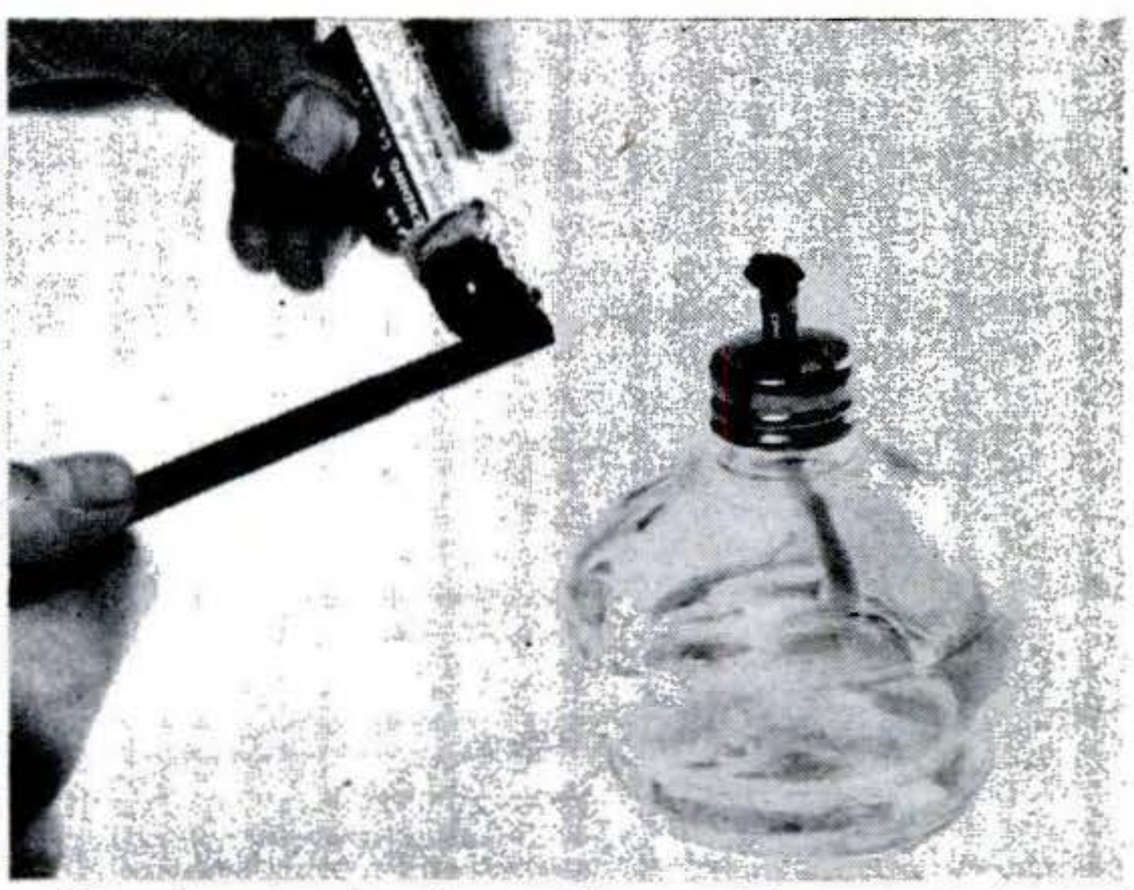


Make a rack out of pine to hold the rod while you wrap the guides and ferrules. Store the spools of thread on a dowel set into holes bored in the sides.

Heavy silk buttonhole twist is best for binding the guides to the pole. You can use one color for simple wraps, or threads of two colors for more flair.

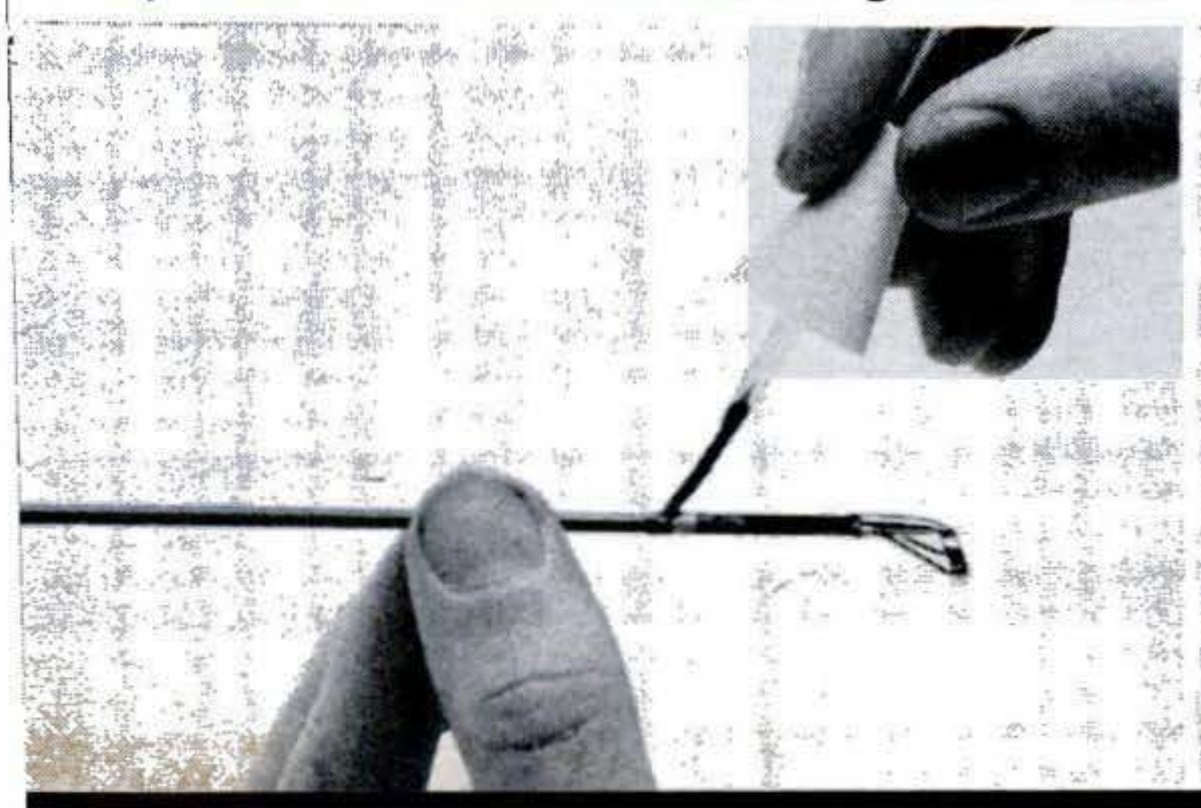


To start a wrap, tape the thread to the rod and then wind it back over itself. Twist the rod with one hand. Guide thread and keep it taut with the other hand.



Glue ferrules in place with special cement, heated and applied to rod while soft. Warm ferrule and slip onto rod. Wrap half-inch of ferrule and inch of rod.

Clear nail-polish coating applied to wrappings darkens colors less than varnish. Once the polish dries, top coats of varnish will not change their color.



Replace worn or missing sections of a cork handle with a cork bottle stopper. Glue in the new piece with ferrule cement. Rasp to size and sand smooth.

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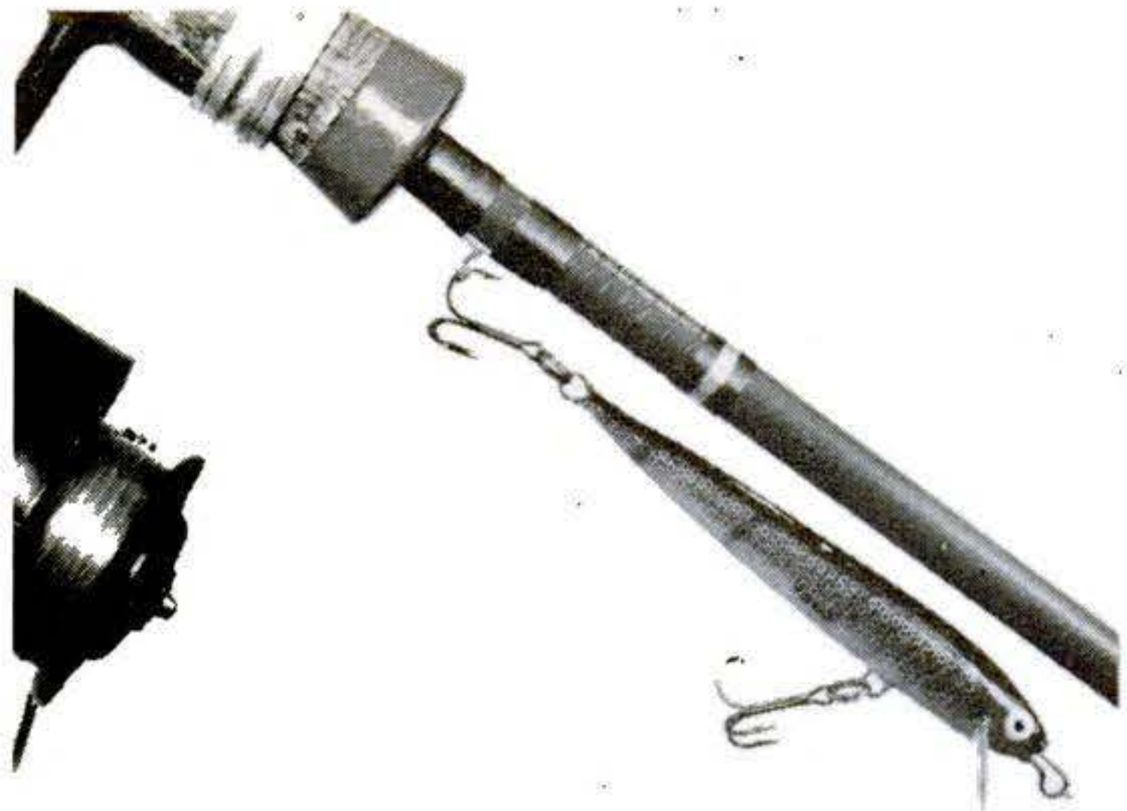
Crutch tip slipped on the end of the handle will keep the butt from wearing out, and also keep the reel-mounting rings from slipping off the handle.



Small keeper eye installed at the base of the rod will hold hook or lure where it won't get snagged when you move from one fishing hole to another.

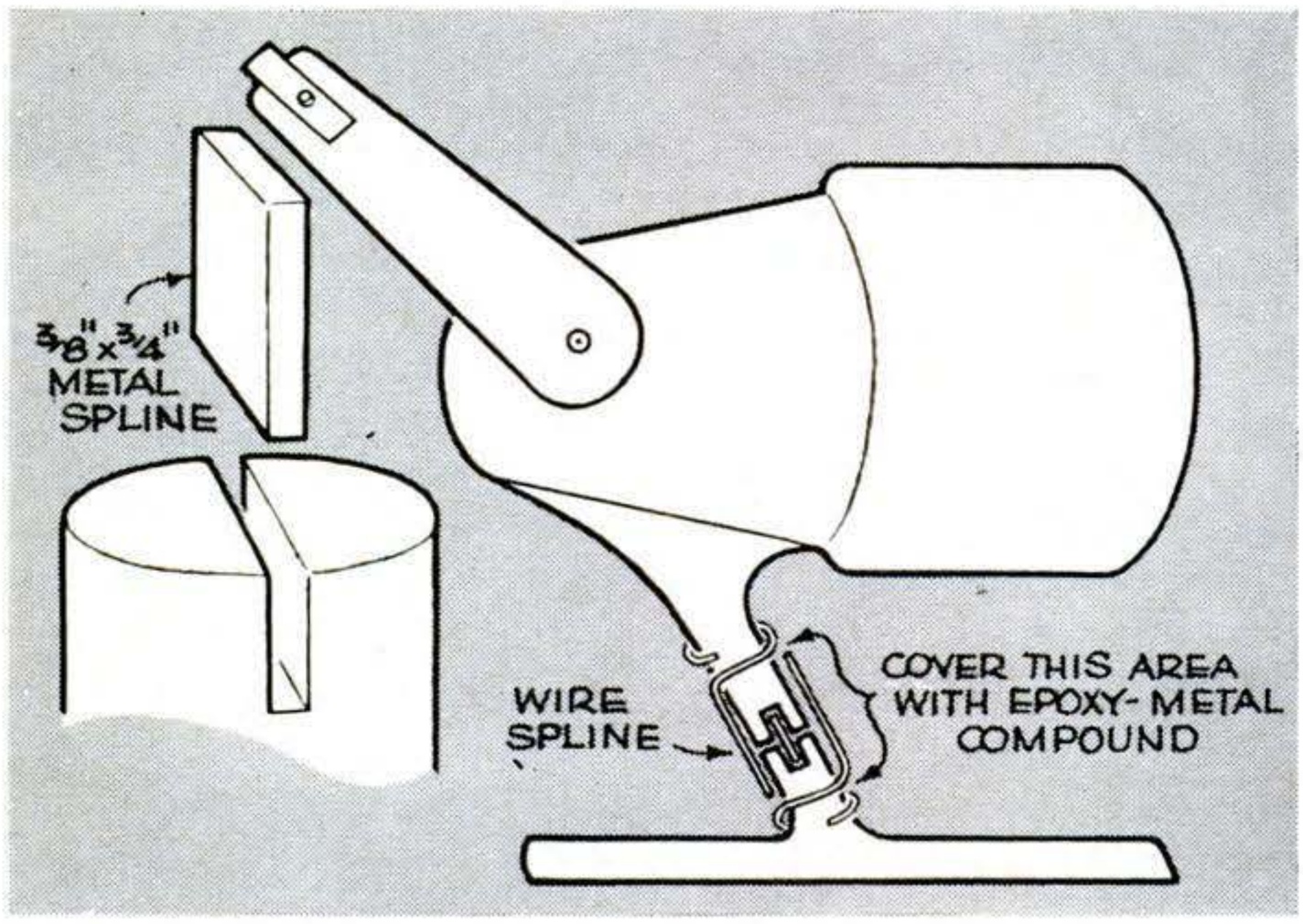
easy. Start by using tape on one end of the guide, to hold it in position, and wrap the other end. Remove the tape and finish winding. Then coat the thread with clear fingernail polish. This keeps the winding from raveling while you wrap the rest of the rod, and the nail polish seals the thread so it won't darken unduly when you varnish the entire rod at the end of the job.

If you have accidentally broken off the tip of a rod a few inches from the end, you can remount the tip guide by reducing the rod's diameter. Spin the rod while pinching the tip between two pieces of sandpaper until the guide fits. Cement it in place and wrap it.

If a ferrule won't come apart, heat it gently and then pull with a twisting action. If it still won't separate, heat it enough to soften the cement holding it to the rod's sections; then remove and replace it. Wrap the first ½" of the new ferrule, and wind on down the rod about 1½". Keep the new ferrule lightly greased and it won't freeze on.

To replace worn or missing rings in the cork handle, use large bottle stoppers. If a ring to be replaced is at the butt of the handle, drill a hole through the cork to fit the rod and cement the new piece in place with ferrule cement. Rasp to size and sand smooth. If the ring is in the middle of the handle, cut the replacement ring in half and cement it back together around the rod.

Now, when fishing season opens, you won't waste time getting ready. PS



Aluminum spinning reels can be repaired

Spinning reels usually break at the center of the support. Since you can't weld the aluminum-zinc alloy, scrape paint off both pieces an inch or so back from the break. Cut matching ⅜" hacksaw kerfs in the broken ends and insert a ⅜"-by-¾" aluminum spline. Tap the ends to hold it; reinforce by shaping two 1½" strands of 12-gauge copper wire to the support. Secure with fine thread; coat assembly with epoxy metal cement.—*H. Buroker, Santa Rosa, Calif.*

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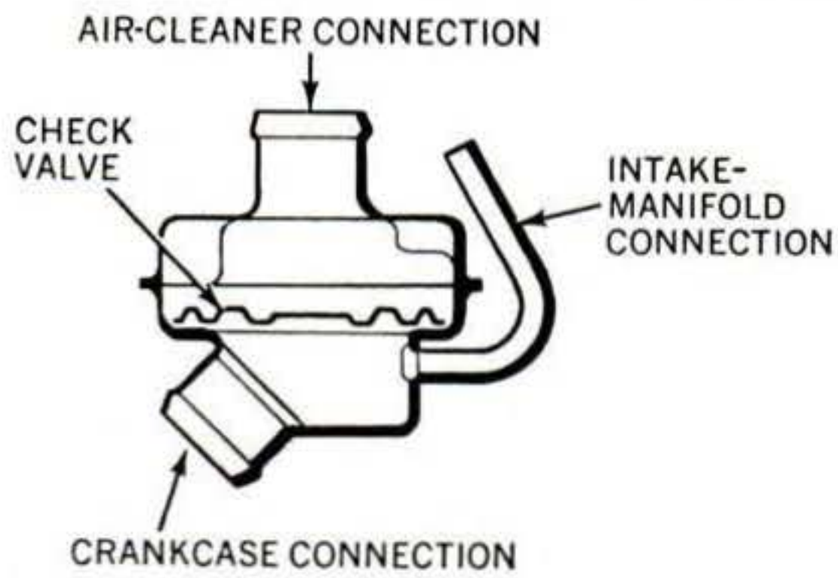
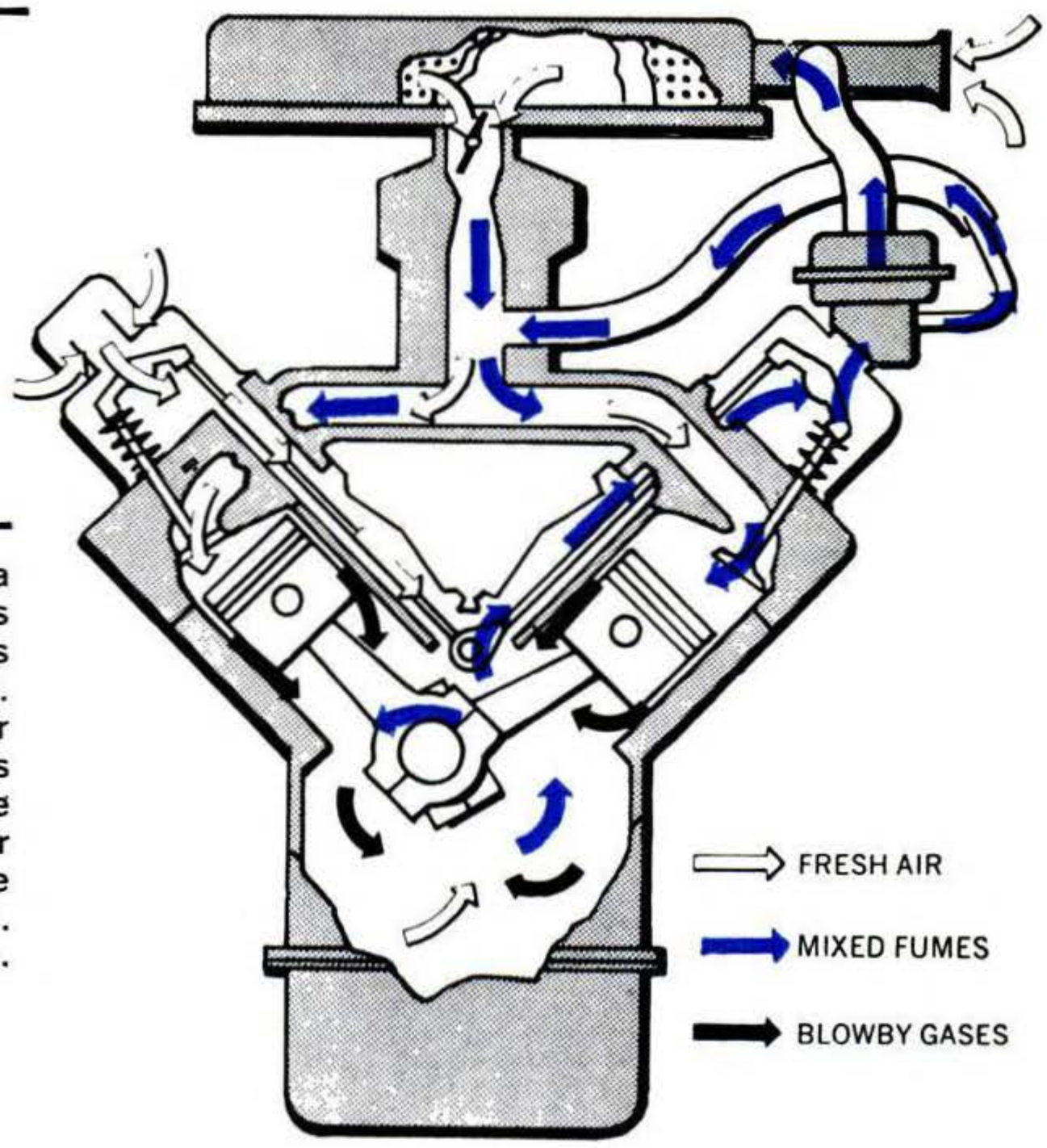
Here's the latest in Popular Science's series for the car owner who doesn't have a very clear idea about what goes on under the hood—but would like to learn. Knowing your car will save you money and add to your driving pleasure and safety.

ABCs of Keeping Your Car in Tune



This type of PCV system uses a dual valve that draws fumes from the crankcase and feeds into the manifold at low speed. At high speed, increased air flow in the air cleaner opens the check valve, and fumes are fed to both manifold and air cleaner. The dual valve can be cleaned but not dismantled. The system is in limited use.



EIGHTH OF A SERIES:

How to Take Care of the PCV System

By HERB CARRIER

You can detect, prevent, and correct PCV troubles quickly—if you know your system

Getting poor gas mileage, burning oil, stalling frequently, idling rough? If you're driving a '63 model or later, your troubles could be due to a malfunctioning intake-manifold, vacuum-type, crankcase-ventilating system, the technical term for what is often called PCV—positive crankcase ventilation.

Why is crankcase ventilation necessary? Just as the upward motion of the pistons serves to compress the air-fuel mixture, the downward motion tends to compress the air in the crankcase. Neither pressure nor vacuum is desirable in the crankcase. Pressure in the crankcase can lead to complaints of oil

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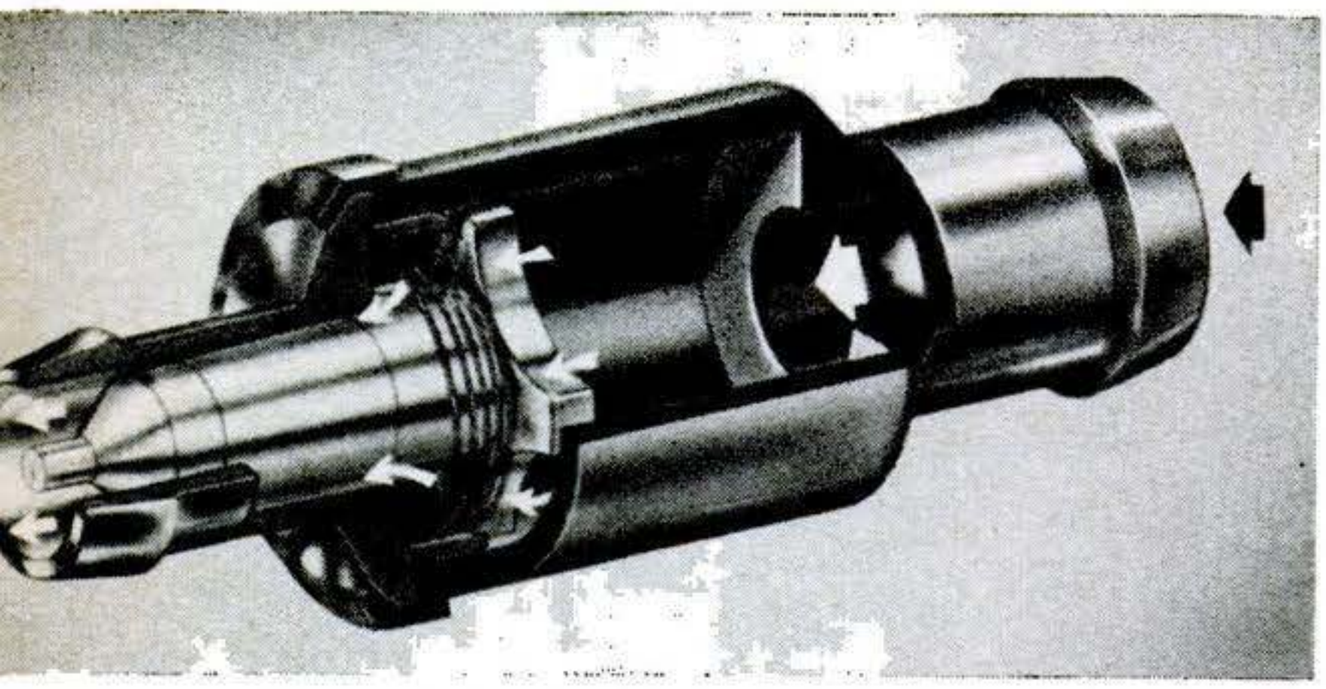
burning, since it forces oil past the crankshaft oil seals and up the dipstick tube.

Crankcase ventilation is also necessary to help remove harmful elements from the area. It's virtually impossible to keep water out of the crankcase. Drops of gasoline also seep into the crankcase, especially during choke-starting and warm-up. Some combustion gases blow past the piston rings into the crankcase.

Methods of ventilation. On most pre-1960 engines, crankcase ventilation was accomplished by air entering through the filtering material in the oil-filler-hole cap. The air circulates inside the crankcase, exhausts through a road-draft tube.

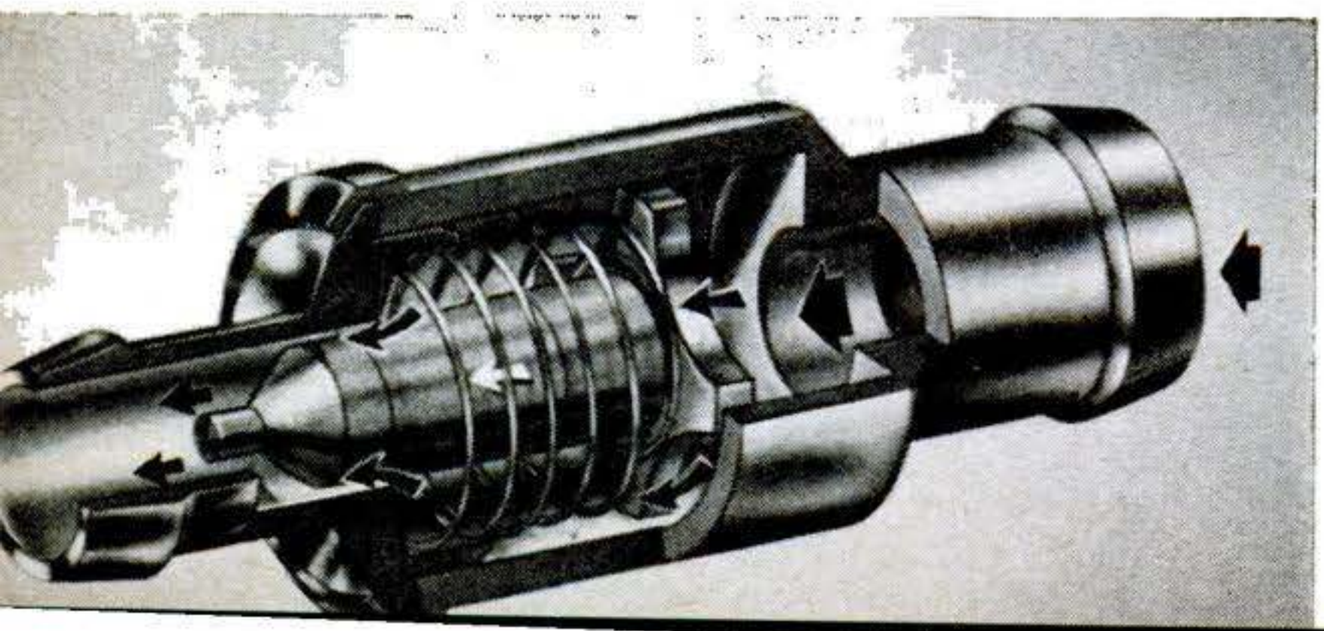
The road-draft-tube system works only when the vehicle is in forward motion at speeds above about 20 m.p.h. because air enters and leaves only by the vacuum formed at the mouth of the tube as air rushes past it.

Smog control. Car engines contribute to air pollution. About one-third of all pollutants blamed on engines without PCV are emitted from the crankcase. For 1963 models and later, the road-draft-tube system was abolished nationally. On PCV-equipped cars, the fumes are routed back through the engine's cylinders for reburning.



PCV valve is closed at high vacuum—but some gas flow is permitted even when the valve is in the closed position. Carburetors are calibrated to tolerate this level of mixing, but a faulty valve can ruin your engine's performance. The PCV valve should be cleaned at regular intervals.

Under low-vacuum conditions, the PCV valve is fully open and permits maximum flow of gas. Note the machined shoulders on the valve-housing ends. Hose-retaining clamps are positioned inboard of the shoulder to assure leakproof connections.



While many modifications exist, only two basic PCV systems are used: the open system and the closed system.

In open PCV, a hose connects the crankcase to the intake manifold. A valve controls the flow of vapors into the manifold. On some installations, there is no valve. Instead, a metering hole in the filler-hole cap controls the flow rate.

In open systems, excessive fumes can blow back to the atmosphere through the filler-hole cap. Consequently, the system is not 100-percent effective.

In closed PCV, the same type of hose connects the crankcase to the manifold. The oil-filler-hole cap is sealed. A second hose connects the crankcase to the engine air cleaner. Excessive fumes in this system are routed through the air-cleaner circuit, rather than to the atmosphere. This system, therefore, is fully effective.

The PCV valve can be one of three types: orifice, constant action, or dual action. The dual-action valve, introduced by AC Spark Plug Division in 1962, is in limited use. The most popular valve is the constant-action type. The orifice valve is practically out of production.

Valves are used to control the flow rate into the intake manifold, air cleaner, or base of the carburetor, depending upon design. One popular V-8 engine has a flow rate of 1.5-4 cubic feet per minute. Too slow a flow rate doesn't provide adequate ventilation. Too fast a rate adversely affects oil oxidation within the engine. PCV flow and carburetor calibration go hand in hand. Any alteration of the PCV upsets carburetion and leads to poor gas mileage and rough idling.

On models built prior to two 1964s (Lincoln and Thunderbird), a typical control-valve assembly consists of a spring-loaded valve in a housing designed to permit easy attachment of hoses and/or manifold, air cleaner, or carburetor base below the throttle valve(s). PCV valve movement is controlled by interaction of spring tension and engine vacuum.

Early PCV valves incorporate two undesirable features: the spring does not rub the housing wall to keep the valve clean, and the valve has a drilled orifice

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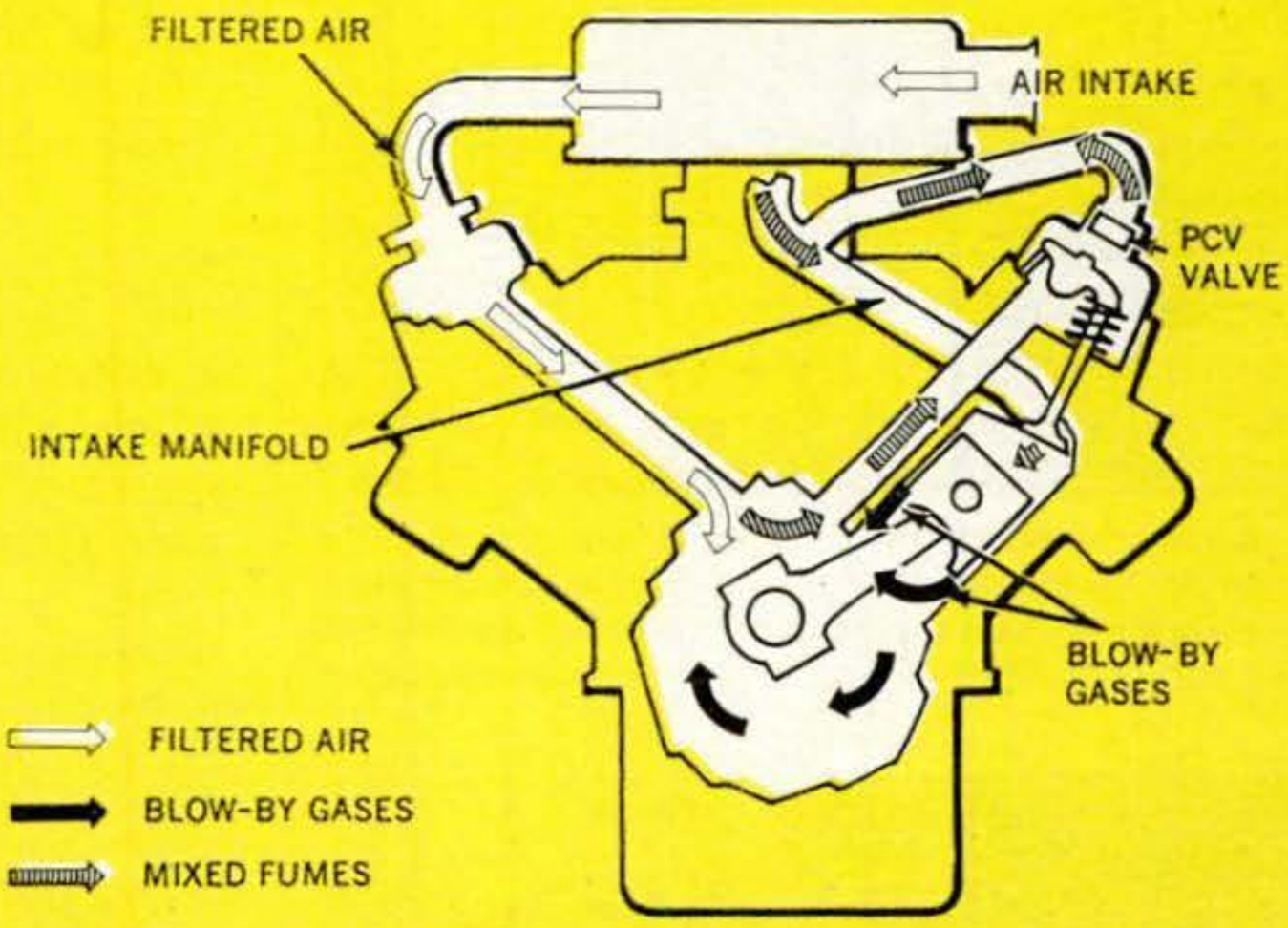
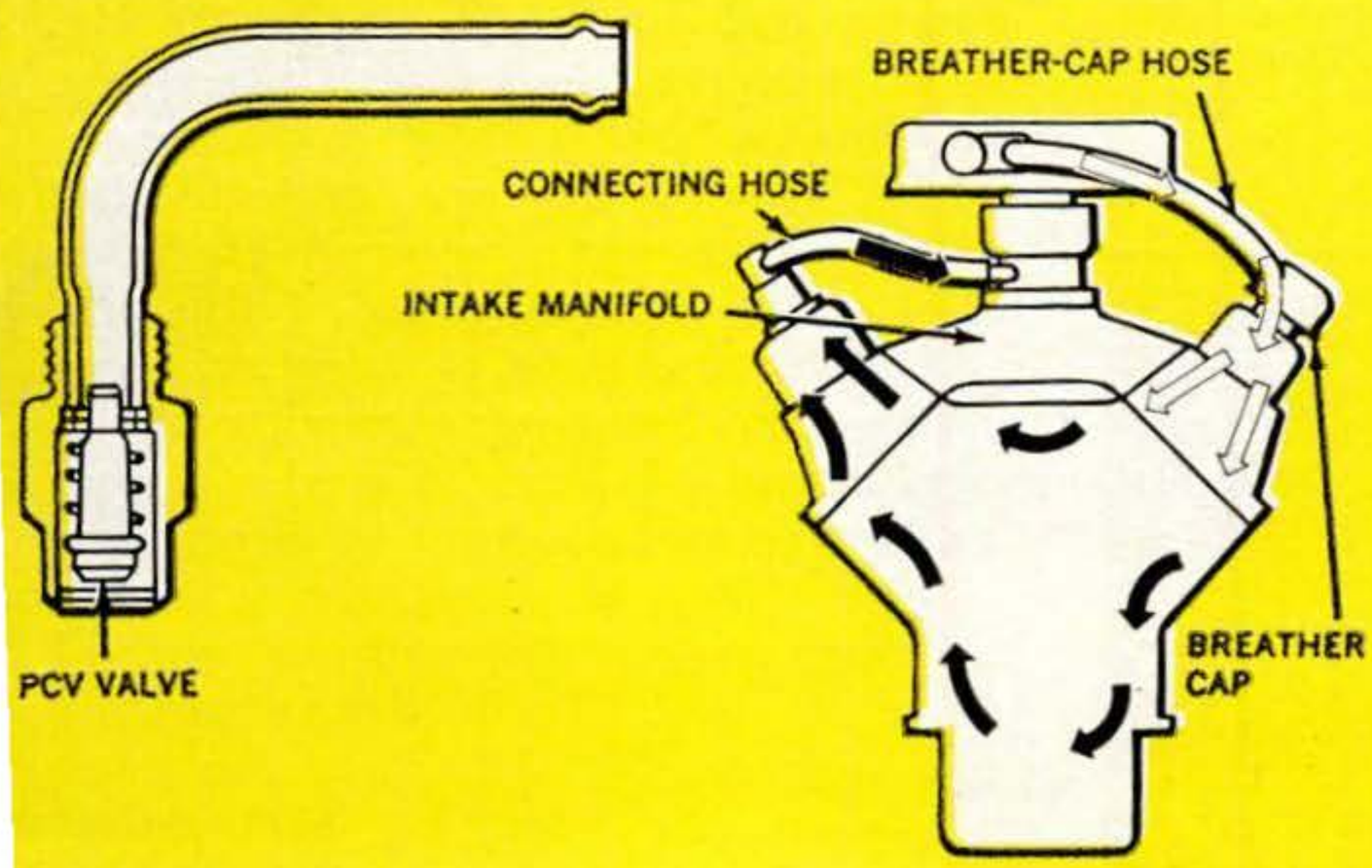
Closed PCV system means that no fresh air enters the crankcase through the oil-filter cap.

Open PCV system has a vented oil-filler cap. Note the differences in the air-cleaner connections.

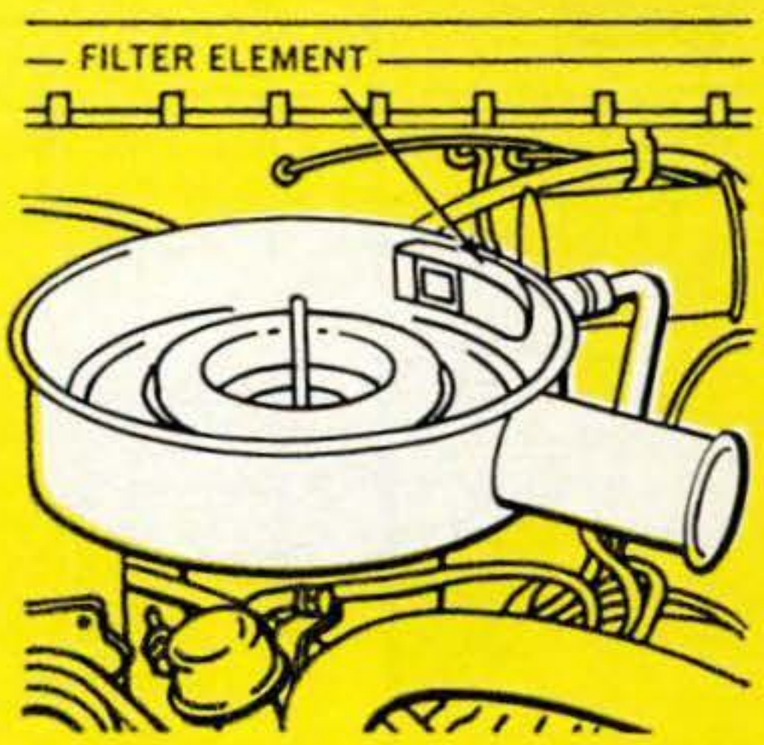
This is the simplest type of open PCV system. No control valve is used. The metering hole in the oil-filler cap controls flow of fresh air through the interior of the engine. Filler cap, hose, and air cleaner must be cleaned at regular intervals for proper performance.



In a typical closed PCV system, fresh air enters the crankcase after passing through the air cleaner. It is mixed with blow-by gases and then drawn through the PCV valve to the intake manifold.



hrysler Corp. engines use a closed PCV system with a special flow-ontrol valve that should be replaced at least once a year. A working alve should "click" when shaken. Do not clean the valve.



Be sure to clean the PCV filter inside the air cleaner on systems that are so equipped. Wash the filter in kerosene. Blow it dry. Oil with light engine oil and shake out excess oil. Refit the PCV filter. It is usually held in position by a special PCV hose clamp.

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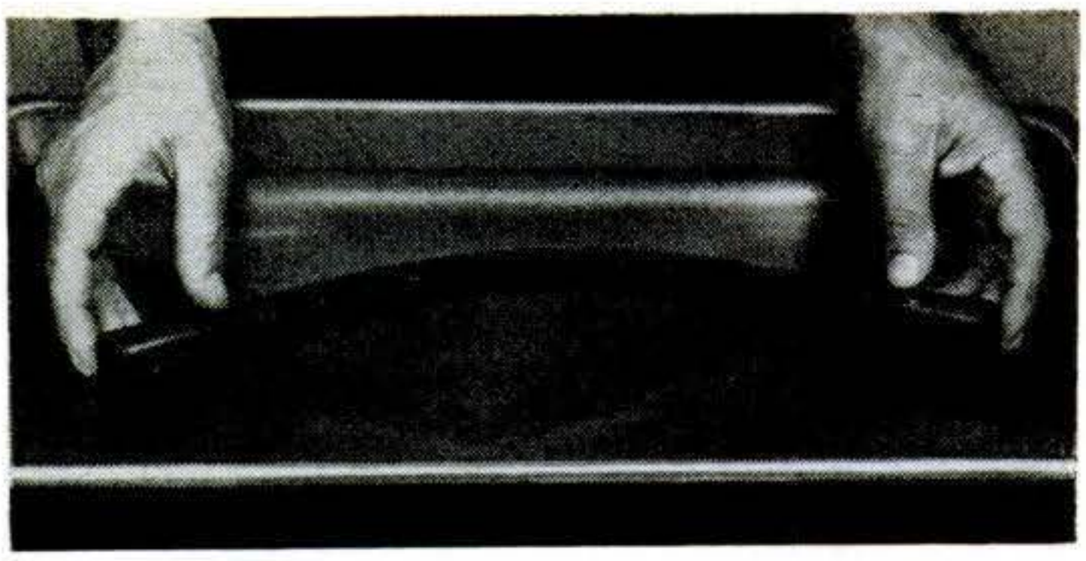
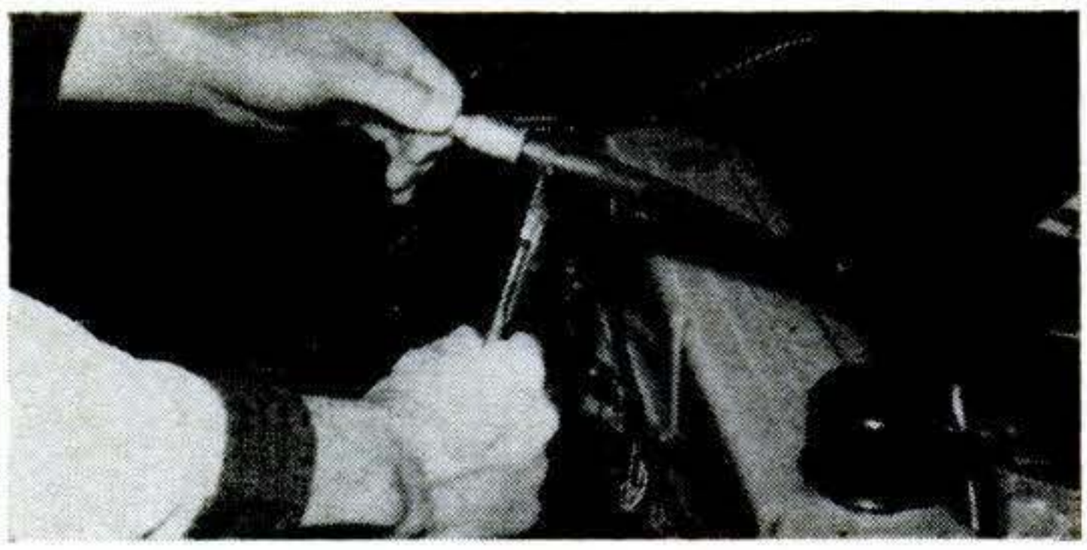
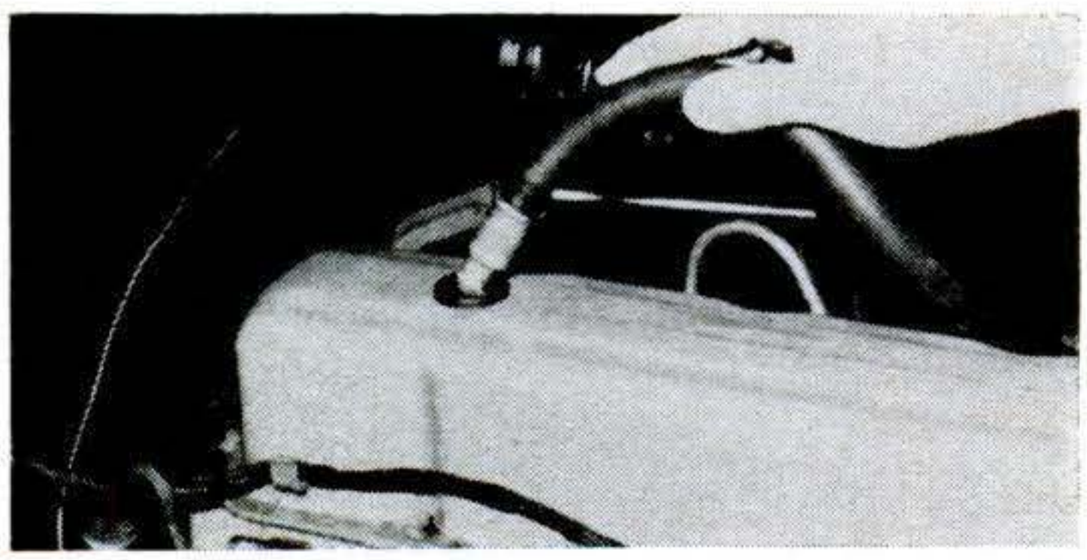


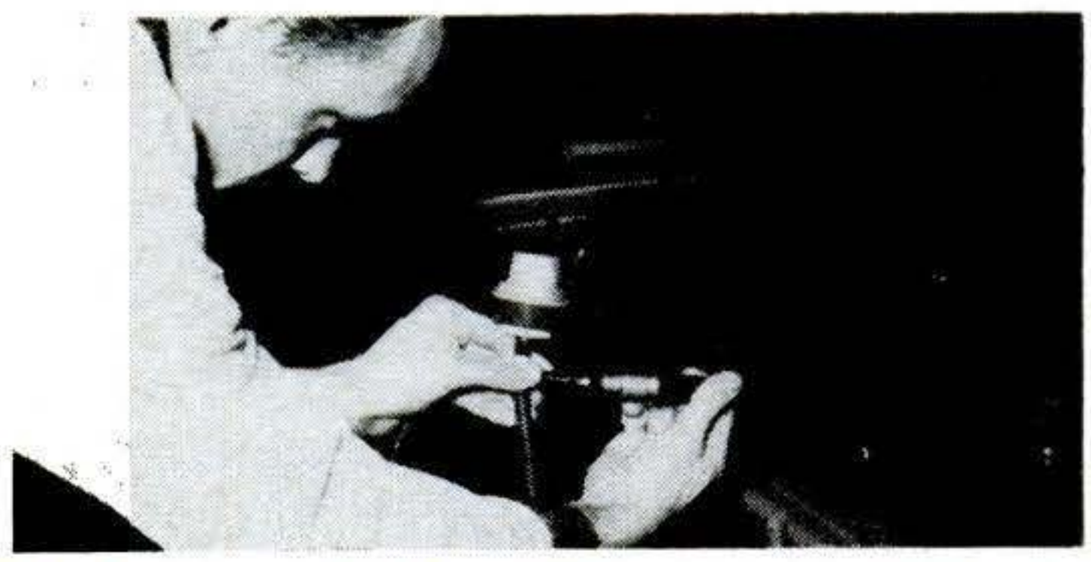
PCV hose cleaning is very important. Soak the hose in kerosene to remove soft deposits. Blow or wipe it dry. Hardened deposits are difficult to remove and often flake off, clogging the PCV valve and shutting off crankcase ventilation completely. Route the replacement hose to avoid low spots.



Connection between the PCV valve and the hose is a simple spring-type clamp. Use pliers to spread the clamp and free the hose for removal. Install the hose and fit the clamp inboard of the valve shoulder.



PCV valve is often press-fitted into the rocker cover. To remove the valve assembly, pull and work the hose until the valve is free. To refit, a light coating of silicone grease is helpful.



Most service stations have testers to check the condition of your PCV system and valve. The tester is simple to use, but it's not a practical tool for the average car owner to buy. A popular tester is color-calibrated for quick and easy reading.

to offer metering when the valve is closed. These valves clog easily.

On later constant-action valves, in common use since the 1965 model year, the spring *does* "scrub" the walls clean and the valve has no drilled orifice. These valves can go many thousands of miles without clogging.

Operational check out. Start the engine and let it idle. Remove the oil-filler cap. Hold a piece of stiff paper (an ordinary envelope works fine) over the hole about ¼ inch away from the surface. If the system is working, the paper will be sucked against the hole within 10 seconds after the engine is started.

Most service stations are equipped with a PCV tester. A popular tester shows air flow through the system in terms of color calibration. Green indicates a good system, red a clogged system. Partially clogged systems show up as green and yellow, straight yellow, or yellow and red. A test is usually free when performed as part of a tune-up, but costs a couple of dollars when performed alone.

Service. Not all PCV valves can or should be cleaned. If the valve assembly can be taken apart, it's okay to clean the valve. If the assembly cannot be taken apart, the valve should be replaced once a year. A new one costs about two dollars.

Soak parts in kerosene, then dry with a lintfree cloth or compressed air. Check the hose(s) for possible cracks. Use oil-resistant hose for replacement.

On those cleanable PCV valves that incorporate a drilled orifice, use a small wire to make sure the orifice is clean. Do not enlarge the orifice, since this is a metering device.

PCV systems that are connected to the carburetor base or adapter under the base often suffer from clogging of the drilled passage in the base or adapter. Manufacturers recommend removing the carburetor and adapter (if used) so that it can be soaked in solvent to clean out the passage. This is good advice, but you can clean the passage without removal of the component. To do this, squirt a solvent such as Gum-Out into the passage to loosen the clogging accumulation. Then use a pipe cleaner (the kind you use on your old briar) to thoroughly clean out the passage. PS

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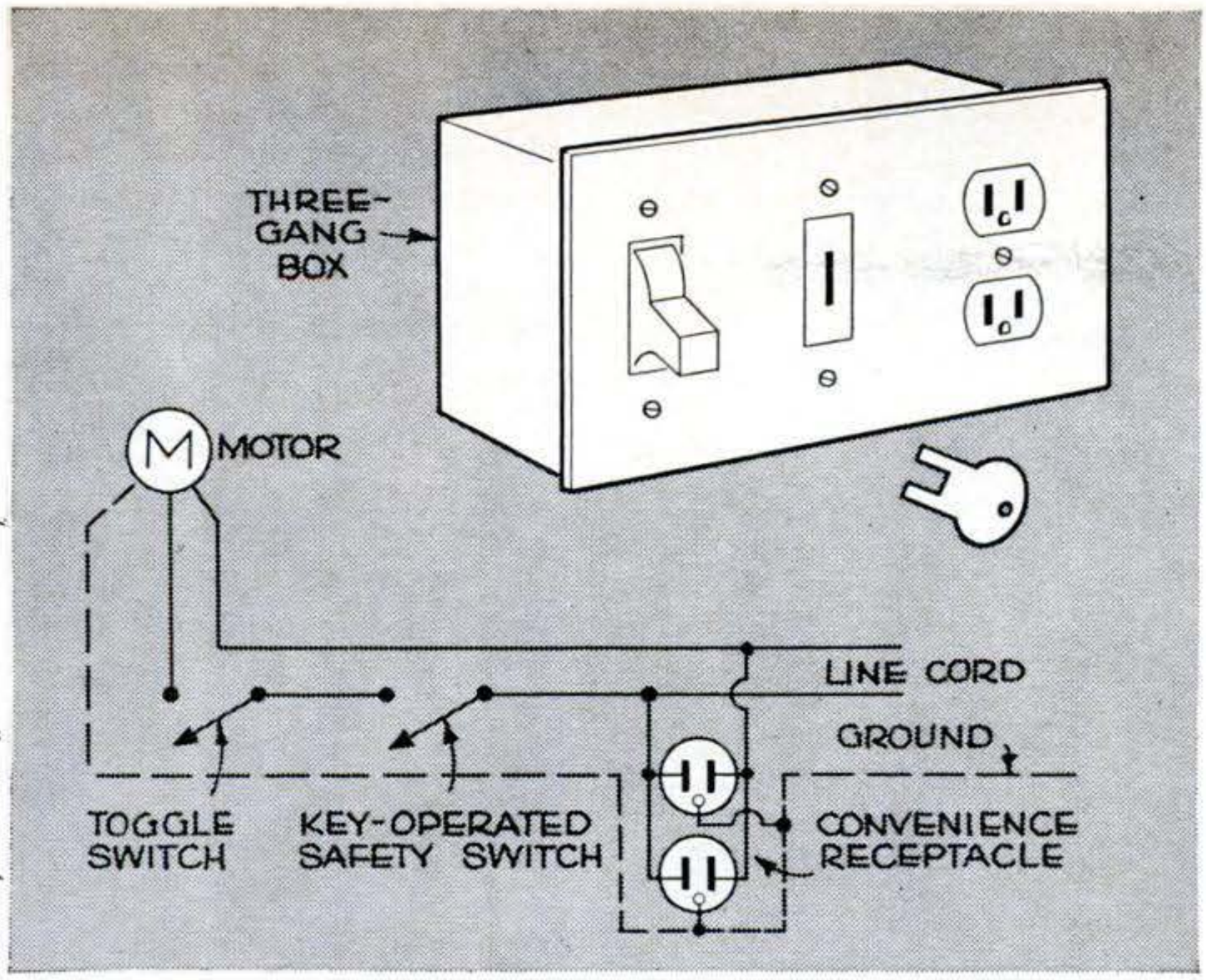


SHORT CUTS AND TIPS

FROM HERE AND THERE

Key switch protects little hands in the workshop

A key switch can eliminate much of the danger to children near power tools. Used to control industrial lighting, the switch fits standard boxes and switch plates. For ⅓-hp. or larger motors use 15-amp specification-grade switch.

ROBERT FINCH
Thousand Oaks, Calif.

More mileage from paint-roller covers

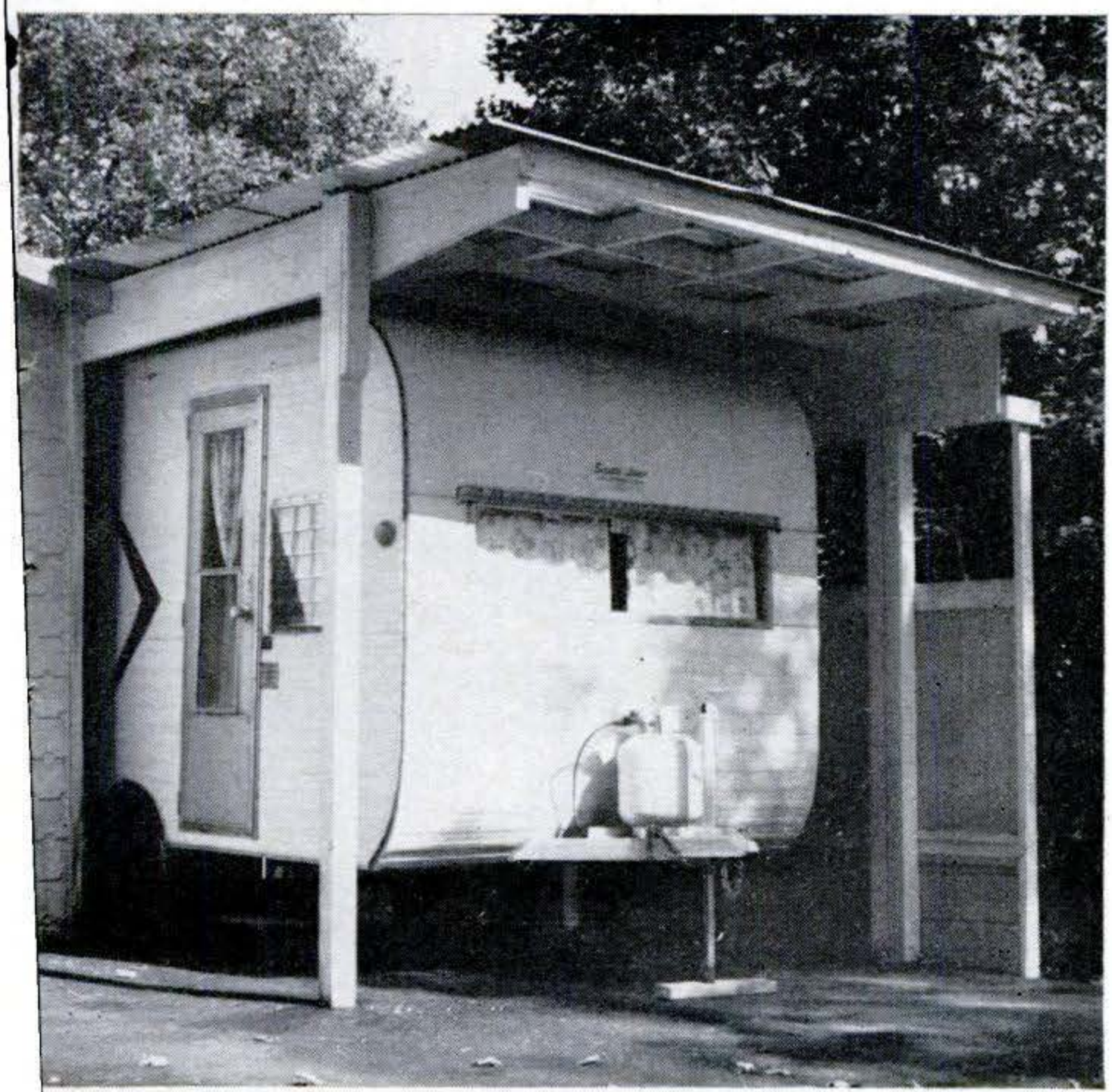
To bring paint-roller covers back to good working condition, remove excess paint (use water for latex, turps for oil base), then follow with a thorough washing in soapy water. After rinsing in warm water, reassemble the roller on the handle. Pass it lightly across a revolving wire brush mounted on your grinder; the brush will raise the nap.

HECTOR BUROKER, Santa Rosa, Calif.

Straightening twisted two-by-fours

Want to straighten a crooked two-by-four? Make a saw cut two-thirds through, midway along the concave side. Snap a chalk line (the length of the board) on the floor and drive a nail near each end. With the board's concave side toward the line, push the board to align its edge with the chalk line. Anchor the work with cleats.

CARL A. RATHJE, Wyommising, Pa.



Winter storage for trailers

Most travel-trailer roofs aren't built to take heavy snow loads. And water that doesn't run off, because of cross-ribs, freezes and opens roof seams. To protect my 14′ trailer I raised the carport roof. A two-by-twelve plank was fastened to the adjoining garage, with the overhang supported by a four-by-four post. The outside header rests on a four-by-four post at each end. Two-by-six joists and bridging provide muscle to carry snow. To prevent snow from blowing in, ½″ exterior plywood was used on the rear and side as well as on the roof. With the protective shed built this way, the trailer can be entered for cleaning or loading, or used for winter storage.

JAMES W. BURNS
Wakefield, Mass.

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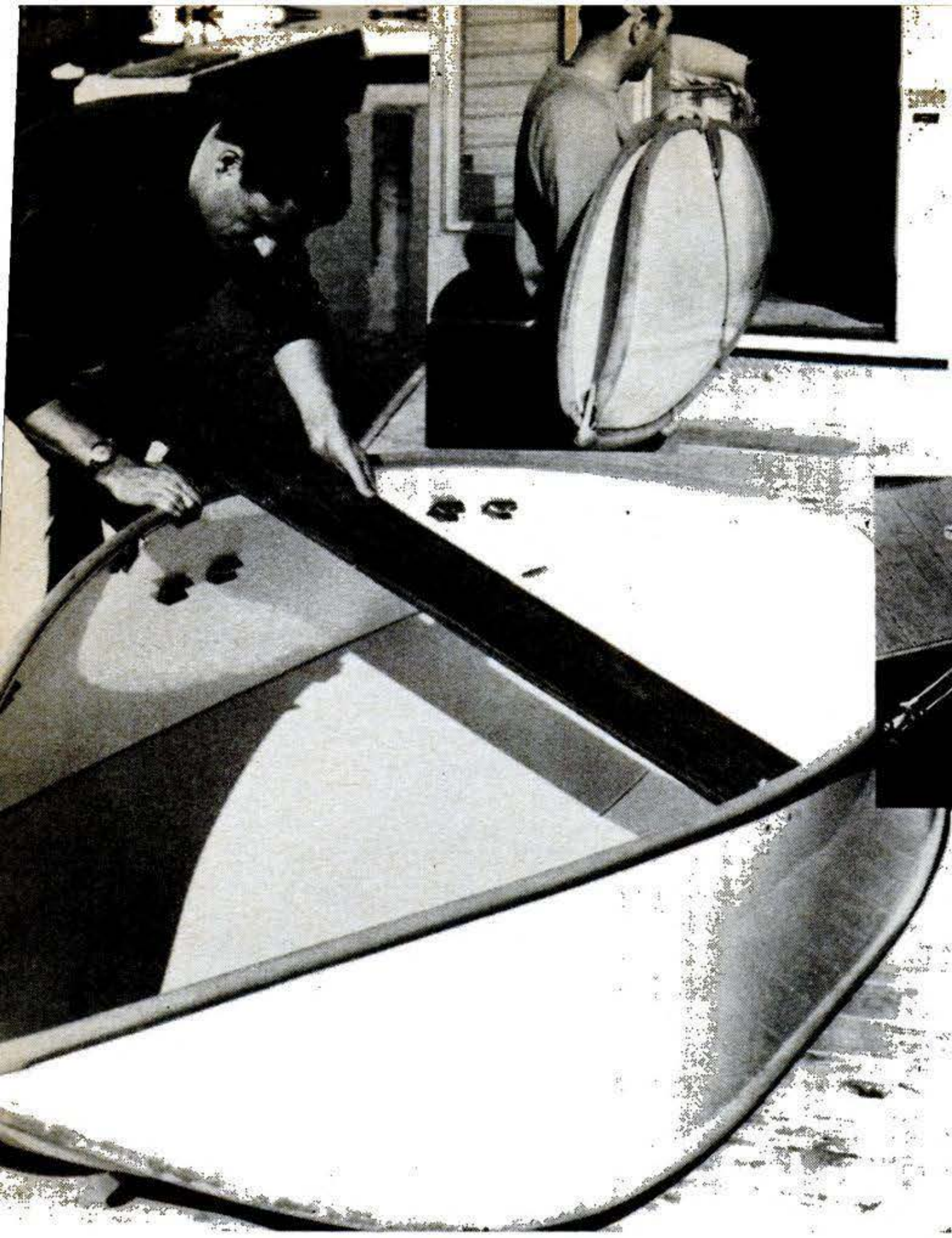
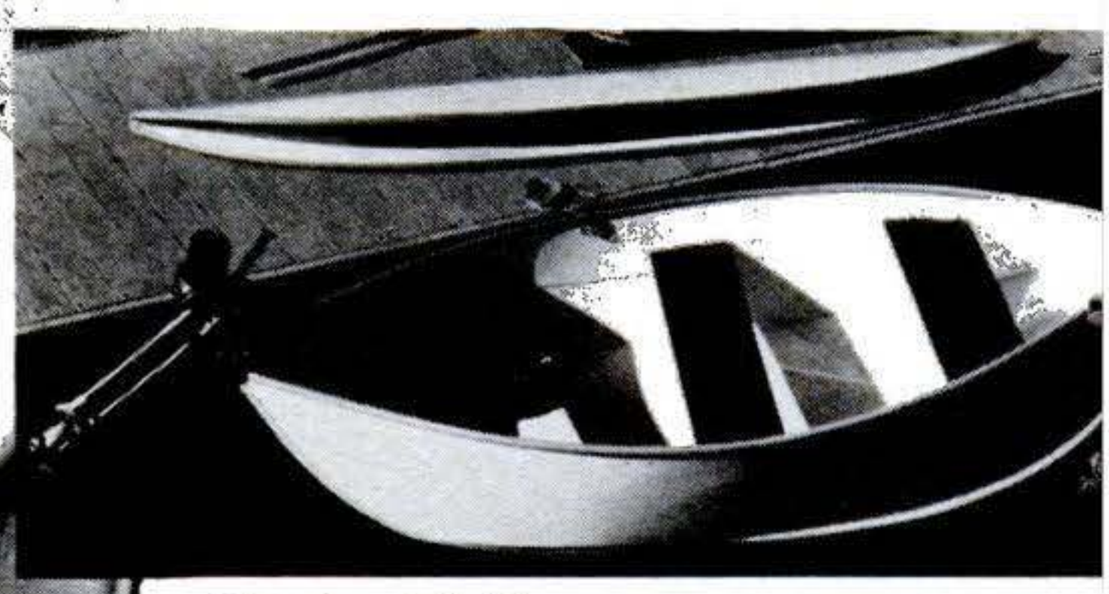


Adventurer 18 (right) is a fold ing canoe from Great Britair It's one of a family of inflat able boats made by A. S. Cav ender & Son Ltd., Cottenhan Cambridge, England. A large model takes five persons. Dis tributed in the U.S. by Ameri mex, 122 W. 30 St., NYC.



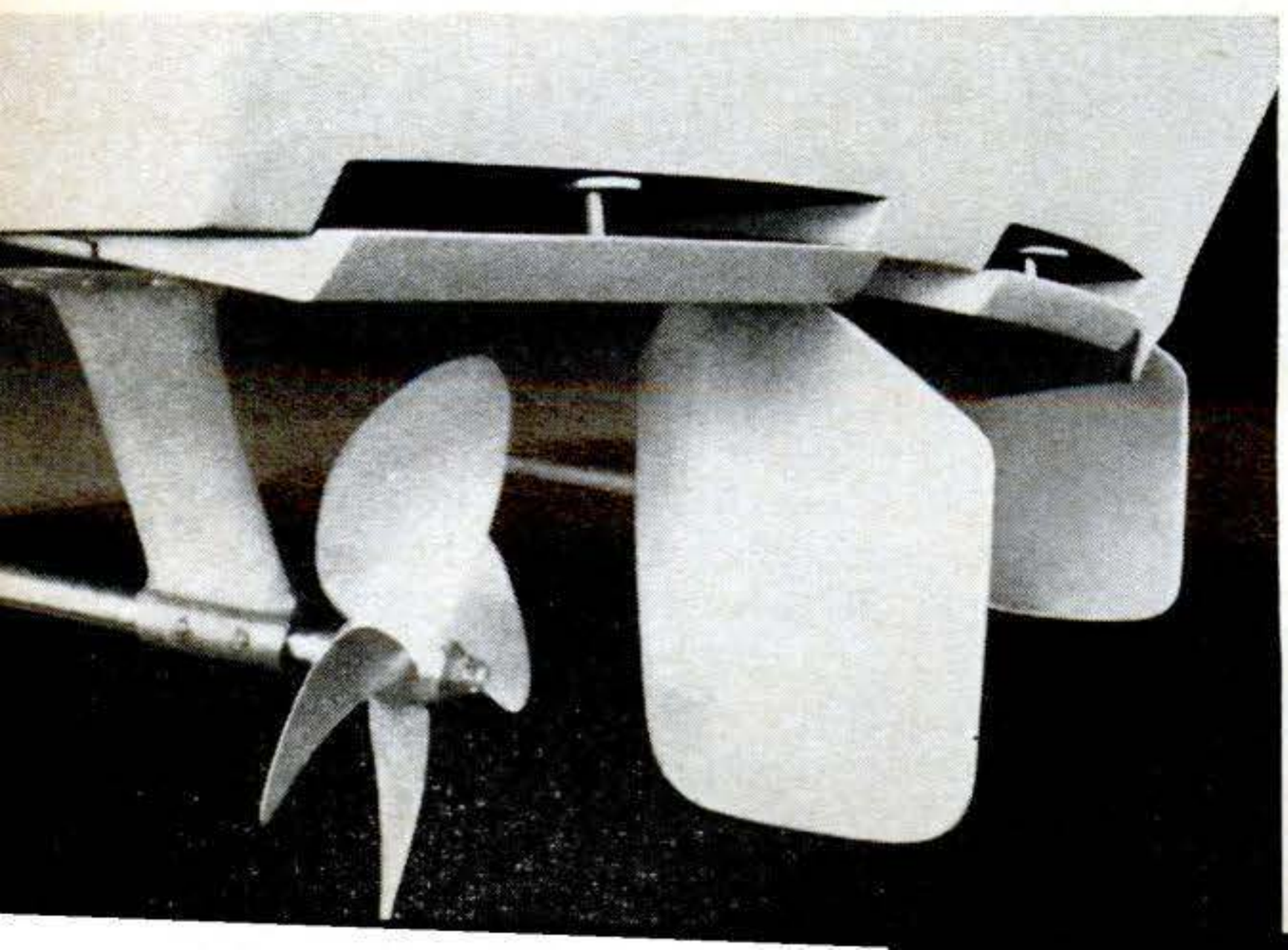
Stowboat folds up so you can carry it in your arms. It unfolds to a nine-foot length, five-foot beam. Weighing only 55 pounds, it is designed to carry four adults. Seats are inserted in a few seconds. The boat folds into a package four inches wide, 24 inches deep, 10 feet long. It can be used as a dinghy, duckboat, or sailboat. Made of polypropylene plastic, it was developed by California Jet Marine, 430 N. Rodeo Drive., Beverly Hills, Calif.

PS BOATING

NEWS FROM THI

Built-in Cruise Control trim tabs are now offered by Chris-Craft. Available on all models of steel and aluminum Roamer cruisers, and several fiberglass Commander models, the tabs function like flaps on an airplane, allowing optimum trim for speed, economy. Dual controls are on the instrument panel. Chris-Craft, Pompano Beach, Fla. 33061.

A new steering system for outboards and stern-drives comes in either rack-and-cable style, or cable-over-pulley. It is also available as a rudder-position indicator. Seven different steering wheels and other modular components enable you to individualize your steering assembly to meet your preferences. Morse Controls, Inc., Hudson, Ohio 44236.



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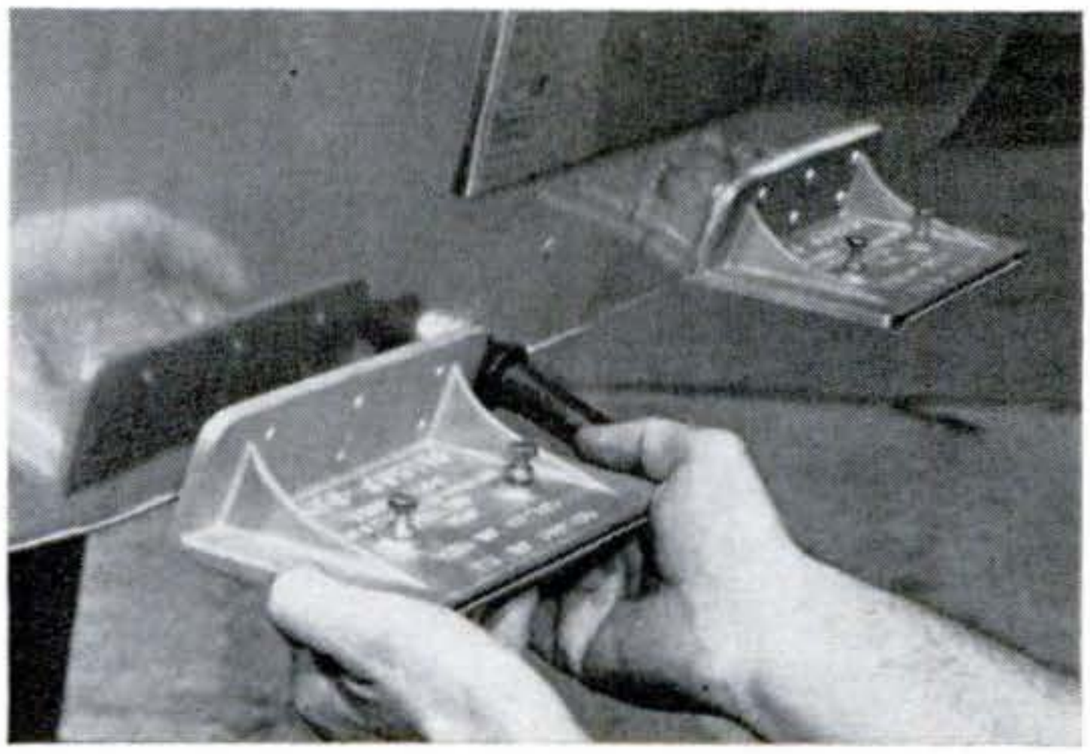

Epoxy-finish aluminum trim tabs help stabilize boats, outboard or stern-drive. They can reduce porpoising, get stern-heavy craft up on plane, compensate for motor torque. The tabs are adjustable and can be installed on all types of boats, including aluminum and fiberglass. Tempo Products Co., 6200 Cochran Road, Cleveland, 44139.

A versatile fishing boat, this new Boston Whaler Menemsha sports a forward cabin. A custom-designed flap-up stand-in, sit-in fore hatch has easy access, and is handy for fishing from the bow. Model shown above is powered by a 55-hp. Homelite four-cycle outboard. Both boat and motor are made by Fisher-Pierce, Rockland, Mass. 02370.

BOAT SHOWS

'68 is the year of eye-popping new ideas. Here's a sampling

A tandem trailer is now built for the big ones. It has a carrying capacity of 4,500 pounds, will handle boats up to 25 feet long. Rollers on outboard cradle supports make loading easier. New 20-inch low-profile tires keep the boat low on the road for a more stable ride, handy unloading. Holsclaw Bros., Inc., Evansville, Ind. 47711.

Sailboat loader makes it easy to car-top a small boat. Rear-support bracket fits all standard trailer hitches. Support consists of a pair of steel mounting pads adjustable to accommodate various widths of sailboats and hull designs. Comes with three tie-down straps. Cosom Corp., 6030 Wayzata Blvd., Minneapolis 55416.

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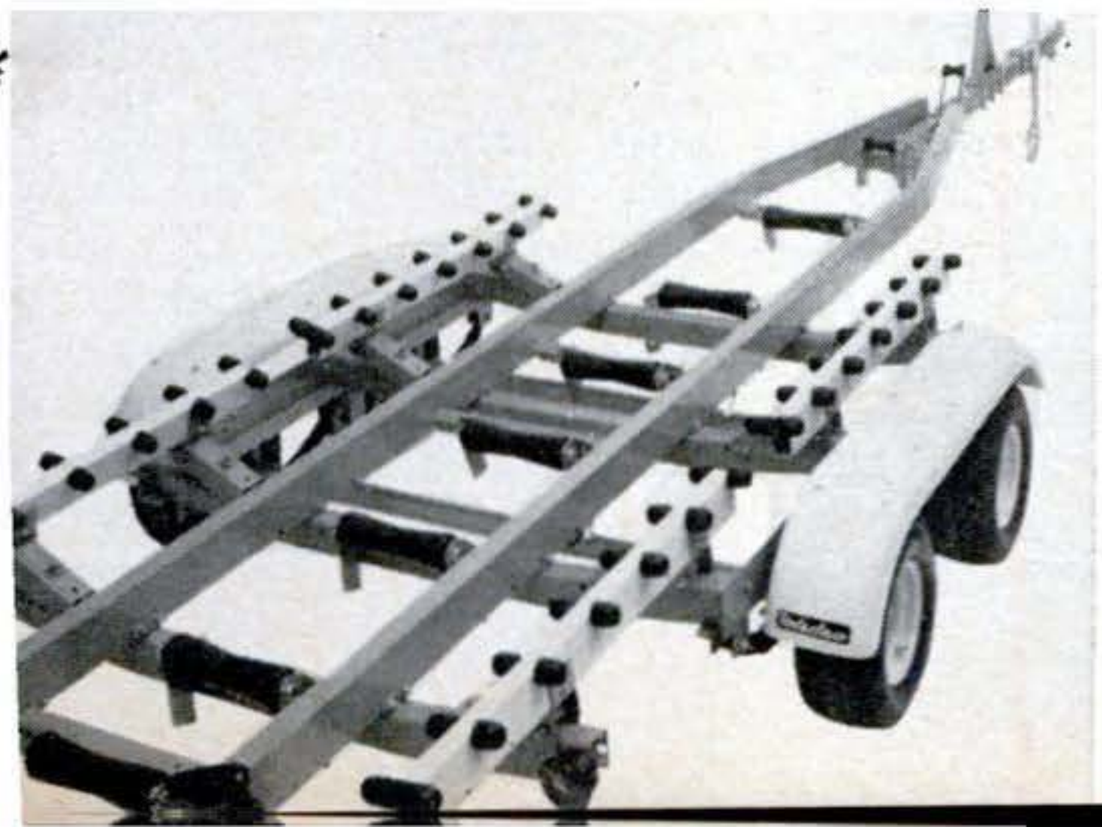
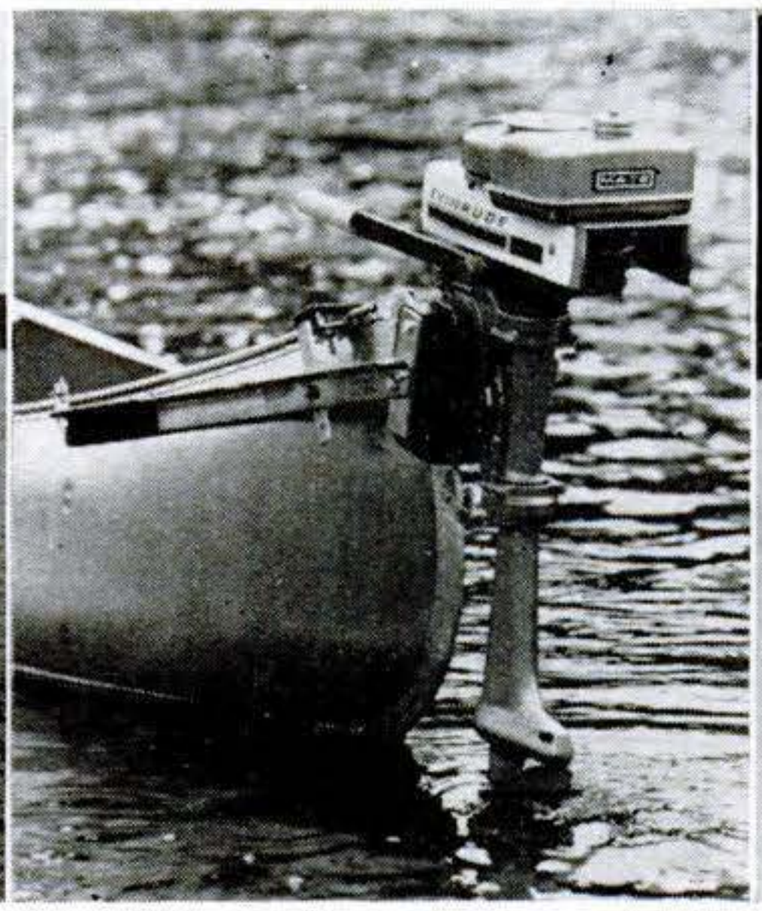


An open-cockpit sportster with midships control console and bow platform, the Commando 151 is new from Chrysler. Maximum horsepower rating is 90. The craft shown here is powered by a 75-hp. outboard. Length is 15 feet, beam 77 inches. Chrysler Corp., Box 2641, Detroit 48231.

An amphibious camper, the Mark III is a combination sport boat, land camper, travel trailer, houseboat, and floating patio. Hull is fiberglass, catamaran design. Its manufacturer says it can be converted fast. Aquanautics, Venice, Fla.

Passing in review is Anchor's '68 fleet of sailboats. They range from the 14-foot Pintail to the Ford 20 Weekender. All have molded-in centerboard trunks, mitered jib sails, and mains woven of Dacron. Hulls are of fiberglass construction for long life. Anchor Sailboats, Union City, Pa.



Stern-mounted outboard-motor bracket for canoes needs no permanent attachment. Four wingnuts secure the six-pound unit to the stern. Canoe can be paddled or poled with motor attached. R & J Talasek, 6442 N. Atwahl Drive, Milwaukee 53209.

Radio direction finder is a lightweight. The new, fully transistorized RDF unit weighs about a pound. You can obtain an accurate fix without maintaining a constant boat heading, says the manufacturer. Hartman Marine Div., Electronic Enterprises, 65 Seventh Ave., Newark, N.J.

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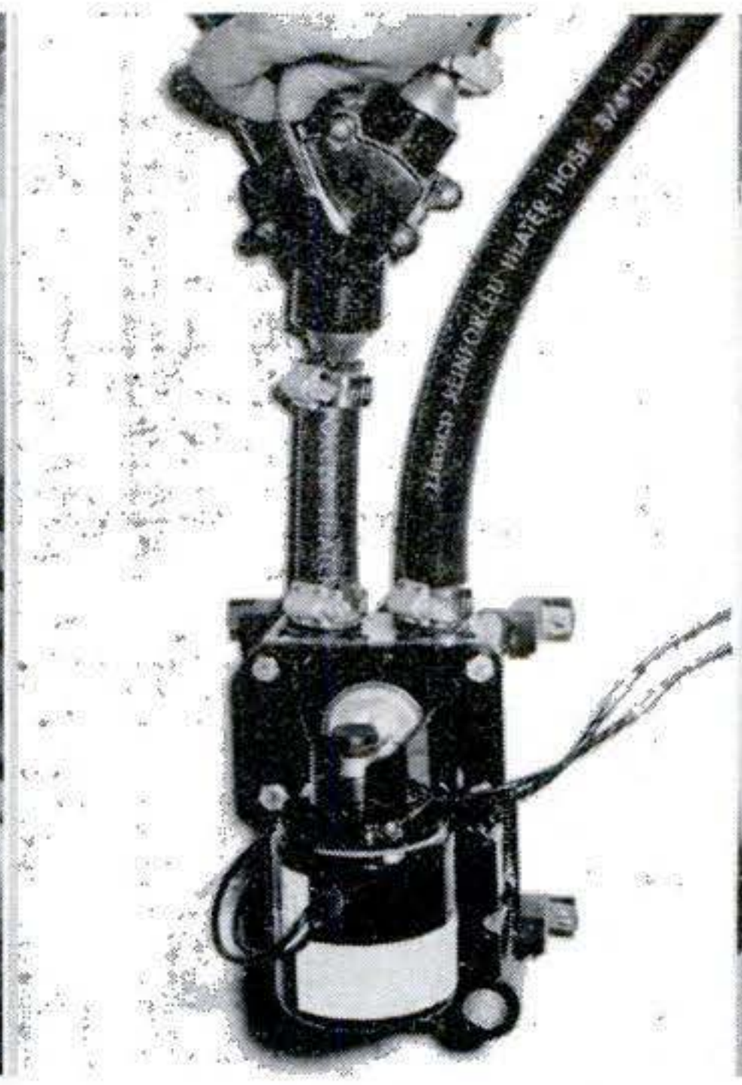
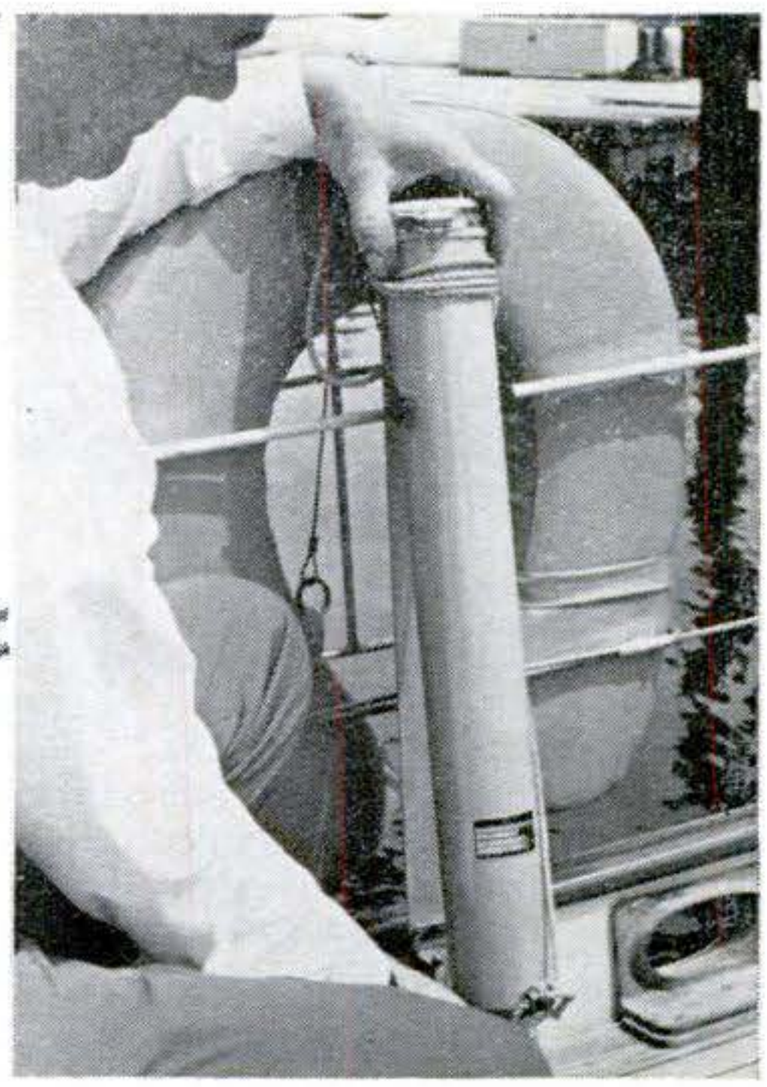
Want to go to sea in style? Try the '68 Hatteras convertible. Forty-one feet of tough seagoing fiberglass, she's completely equipped with live-aboard comfort for a whole family. Gasoline or diesel powered. Hatteras Yacht Co., High Point, N.C.

Nickel-cadmium battery packs are built in under the motor hoods of new 7.5- and nine-hp. outboards from Sears, Roebuck. They eliminate the need for a remote battery, yet bring convenience of electric starting to these low-horsepower fishing motors. The packs recharge quickly.

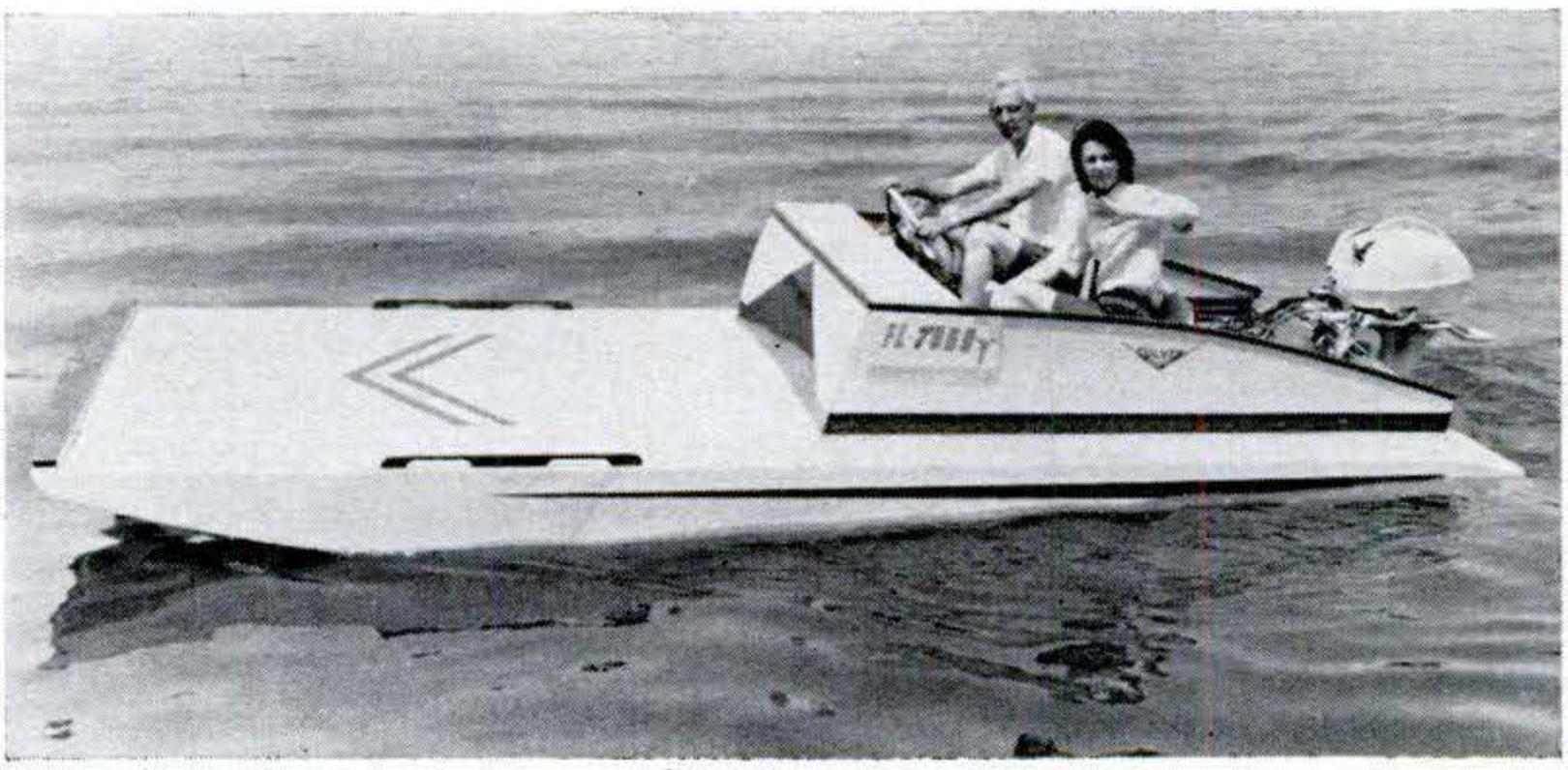


Sea Gulp, Jr. is a versatile, low-cost bilge pump. It may be installed anywhere in the boat, and in any position. The pump is friction-free, and does not burn out if allowed to run dry. Peters and Russell, Inc., 550 W. Liberty St., Springfield, Ohio 45501.



Electronic safety flare uses strobe-light principle. The high-intensity electronic device, contained in a yellow plastic tube, is 24 inches long and three inches in diameter. The self-contained, battery-operated unit flashes automatically. ACR Electronics, 551 W 22 St., NYC 10011.

Oahu Jr. is a catamaran hull with a step in the bottom for high speed. Length is 16 feet, beam 80 inches. Construction is marine plywood filled with polyurethane foam and covered with fiberglass. Culver Boat Co., Center Hill, Fla. 33514 builds it.



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YOUR FIRST

Sailboating is up in popularity.

...under sail

By DICK STRATTON

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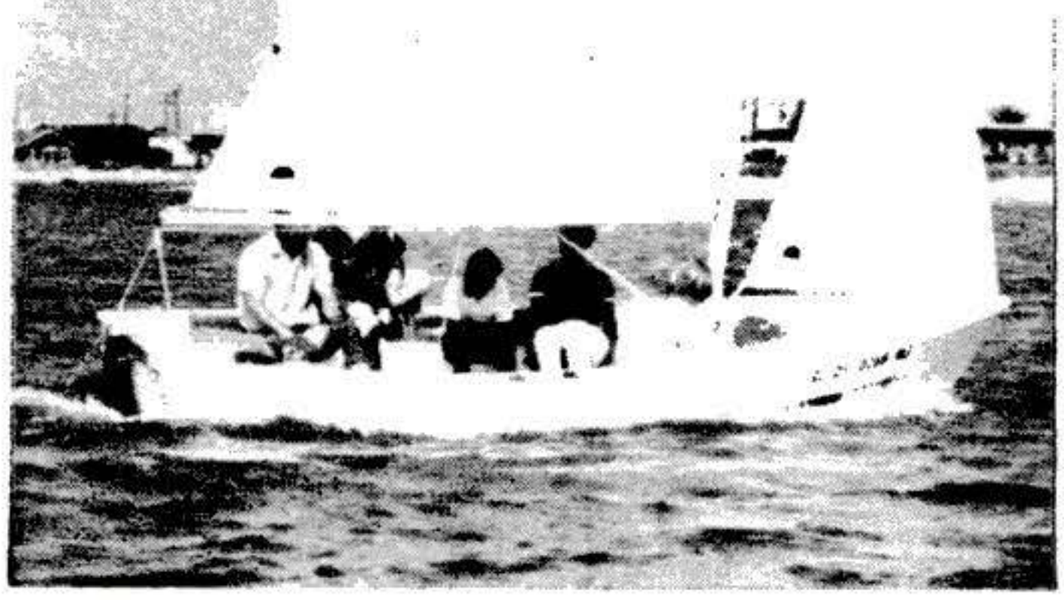

Scooting along under full sail is a Chrysler LS-16 racing sloop. You don't have to be an old-time sailor to handle this sleek 16-foot fiberglass craft, but you must know the ways of the wind.

You can become a competent sailboat sailor in 30 days or less—assuming that you're willing and able to spend a good part of your free time aboard your boat during that period.

Selecting your boat is of first importance. The main things to keep in mind are the size of your pocketbook, the intended use of the boat, and the kind of water you'll be sailing in. As a novice, you'll probably choose a boat less than 20 feet long. If you're thinking about family recreation, you'll want a boat designed for day sailing. But this doesn't rule out racing. Many boats can be used

...under power

By CLEM KOEHLER

Owning your first powerboat is something like becoming a father for the first time. Like the newborn infant, the rig you select is receiving expert care when you first view your prize from a safe distance in the showroom.

Then suddenly the entire responsibility shifts to you—when the nurse hands you the baby or when the marine dealer drops the ignition key in your hand.

The cure for new-boat jitters: Get as well prepared as you can to keep your sense of humor. Also, remember that the new boat, motor, and trailer, like the new baby, are designed to withstand a certain amount of inexperience and ineptitude.

The first step is to see that you have a suitable place to store your boat permanently. It may be in half of your garage, at your summer cottage, at your marine dealer's if he offers winter storage, or in a year-round marina.

No matter where you live, your new powerboat will have to be registered and numbered if it's propelled by 10 horsepower or more. If you use less than 10, you may not have to number your boat. Your dealer will be able to advise you on this.

If you have to register, you'll receive a summary of boating laws in effect. Read it and keep it. Ignorance of the law is no defense.

Your new boat trailer will very likely

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30 DAYS IN BOATING

The U.S. now has more than half-a-million of these pleasure craft

without alteration for both kinds of fun.

What about the waters you'll sail in? A boat that's fine for a small Midwestern lake may not be the type you need for San Francisco Bay. It's best to talk to a local skipper. He can tell you what kinds of boats are suitable for nearby waters.

Once you've picked your boat, equip it properly. These are the essentials: a pump or bailer, tools (pliers and a screwdriver at least), anchor (and line) of the right size and weight for your boat, 50 feet of multipurpose line, a hand light, life jackets for each person aboard, paddle, compass, bucket and sponge, whistle or horn, and a first-aid kit.

You may also want to consider some of this additional equipment: boat hook, fenders, binoculars, small outboard motor, foul-weather gear, flare gun, portable radio, and spare parts such as shackles, tape, and cotter pins.

I'd also recommend a trailer. Most sailboats under 20 feet don't have keels. Instead they have centerboards or bilgeboards that can be raised, making the craft easily trailerable. The mast is carried on top of the boat in brackets or yokes at the bow and stern.

The advantages of trailering a sailboat are pretty obvious. It's more fun to go sailing in a variety of waters. You don't need dock space, which in most places is hard to come by and expensive. And a back-yard berth makes it easier for you to keep your boat shipshape.

Once you've bought your sailboat, your first task will be to assemble, or rig, it. Most small boats come with rigging instructions, but they're usually written in the jargon of sailing. However, as a rule, the instructions are accompanied by diagrams explaining the boat's components. After a short study, you'll begin to understand the terms used.

There are two kinds of rigging. Wire

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Powerboating requires its own skills, but they are easy to master. Here an outboard model has taken a young group out quickly to an ideal scuba-diving location—and will get them back home fast, too.

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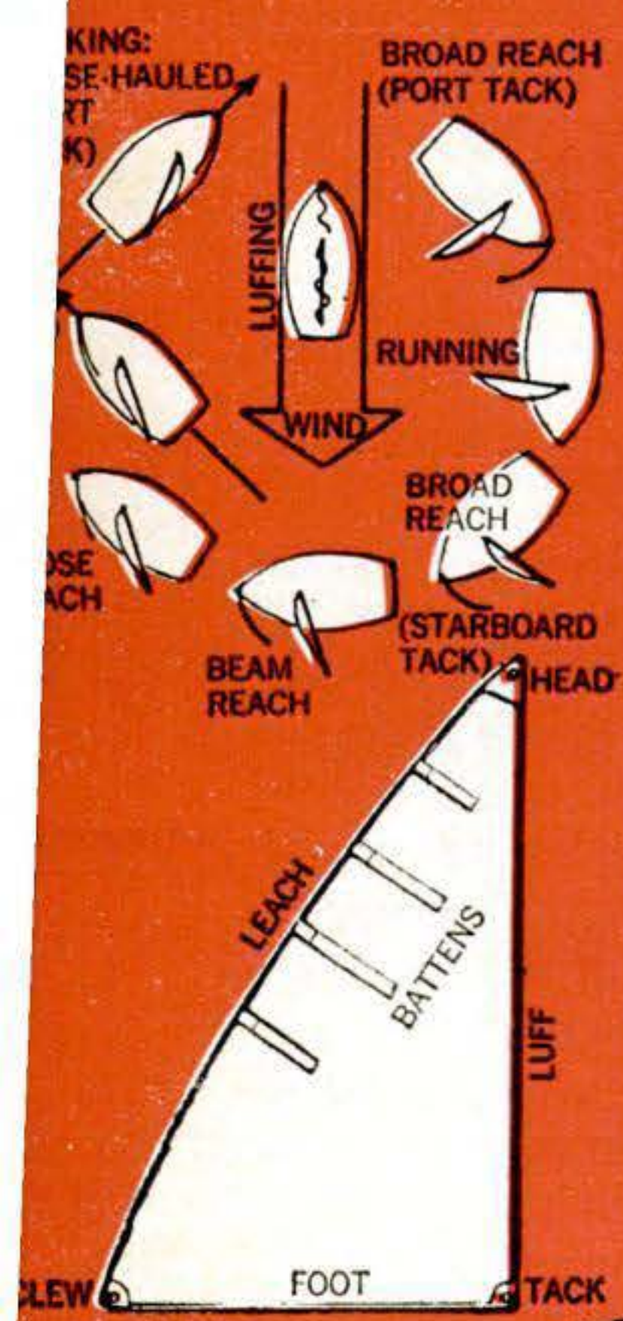

How to take advantage of the wind in sailing

The direction in which you point your boat in relation to the wind is your "angle of sail." The main angles are: close hauled, close reach, beam reach, broad reach, and running (top drawing at left). Positioning the sail is another element. You don't position or trim the sail so the wind hits it squarely. The wind should strike the sail at luff and thrust off at leach (middle drawing). How far the sail should be in or out—trimmed—is determined by watching the luff. Drawing at bottom left shows how a sail reacts to wind. Directly below are shown some of the accessories you need for successful sailboating.

strands that hold the mast in place are called the *standing* rigging. The ropes (or lines) that control the sails are called *running* rigging. You'll soon become familiar with other terms, too. And as soon as possible, either through reading or instruction, you'll want to learn how the mast and rigging can be tuned to give your boat maximum performance.

Now let's go sailing. Many people have taught themselves to sail. But I recommend starting out with a sailing instructor. Let him teach you the basics. Your knowledge will grow quickly in just half an hour. And you'll be amazed at the proficiency you can acquire in only a few hours of sailing under the guidance of a veteran skipper.

I think it's also a good idea to read about sailing. A list of sailing books can be obtained by writing to the American Sailing Council, 420 Lexington Ave., NYC 10017.

All sailboats have one thing in common: They're powered by the wind. The wind comes from many different directions, so a sailor must know how to set his sails for the direction in which he

have to be licensed by the same state agency that issues your auto tags. A few states, including Oklahoma, Tennessee, Kentucky, and North Dakota, don't require a license for your boat trailer. Don't overlook the important factor of brakes for your boat trailer. Most states require that your trailer be equipped with its own brakes if the gross load (trailer, boat, motor) exceeds certain limits. The limits vary from state to state, as do requirements concerning safety chains and lights. Ask your dealer.

One of the best things the new boater has going for him is the excellent warranty on most marine equipment.

Owner's guides are invaluable. If you want to take a lot of kinks out of your first 30 days of boating, read yours from cover to cover.

Here are a few other matters you should attend to:

- Discuss insurance requirements with your agent. You'll want to consider coverage for damage and theft, as well as liability insurance to cover property damage and personal injury to others. The inherent safety of boating is reflected in the low premium rates for liability insurance. It pays to talk to the agent who wrote your home-owner's policy; its coverage may extend to your boat.
- Before your boat is delivered, find out what size trailer-hitch ball you'll need for your car and have it installed. At the same time, get your car wired so you can plug your trailer lights into your car's electrical system.
- Break in your engine according to manufacturer's recommendations.
- Take pictures of your rig. They're fun, and a real help to police in identifying your boat if it's stolen.
- Purchase whatever safety equipment is required in your state, such as a fire extinguisher and buoyant boat cushions.

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the right boat, right equipment, and some technical knowledge

wants to go. The wind, by hitting the sail, makes the boat move. But what most people don't realize is that it also creates a vacuum on the other side of the sail, which increases the net force pushing the boat along.

The direction in which you point the boat in relation to the wind is called angle of sail (see drawing at left).

You cannot sail directly into the wind. If your course is upwind, you move ahead by making a series of *tacks*. The boat will sail about 45 degrees off the wind. So you get to your windward destination by zigzagging at 45-degree angles.

Let's take another element of sailing—positioning the sail. You don't position or *trim* the sail so the wind hits it squarely. The wind should strike it at the *luff* and thrust off at the *leach* (a look at the drawing will clarify this).

How far the sail should be in or out—trimmed—is determined by watching the luff. Let the sail out until you see the luff flutter. Then pull it in slightly until the fluttering stops. The sail is then trimmed for the particular direction in which the boat is pointed.

You can move in a complete circle with the wind coming in the same direction by changing the trim of the sail continuously as you turn the boat.

There are many other things to be learned: *jibing*, or changing tacks when sailing downwind; *reefing*, or reducing the sail area when the wind gets too strong; using a spinnaker; docking; mooring; anchoring; weather-watching. And for the advanced skipper—racing.

You'll learn that, under the rules of the road, sailboats have the right of way. But not all powerboat operators know these rules. So you'll learn to be flexible.

The wind will make your boat go, but the wind changes speed and direction often enough to keep you from developing complacency or a know-it-all attitude. You'll catch on fast, once you're under sail.

All of this is the challenge of sailing. You'll undoubtedly discover great satisfaction before 30 days have passed. And chances are that, by the end of the month, you'll be well on your way to becoming a seasoned salt. And may all your winds be favorable ones. PS

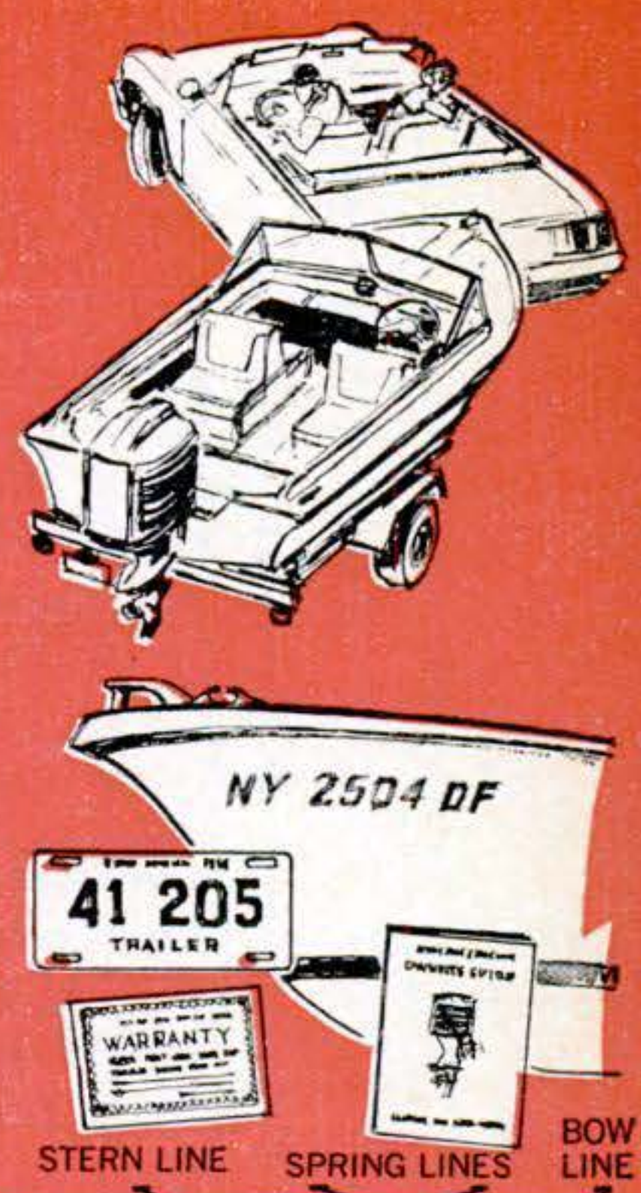
is as wide as the open sea

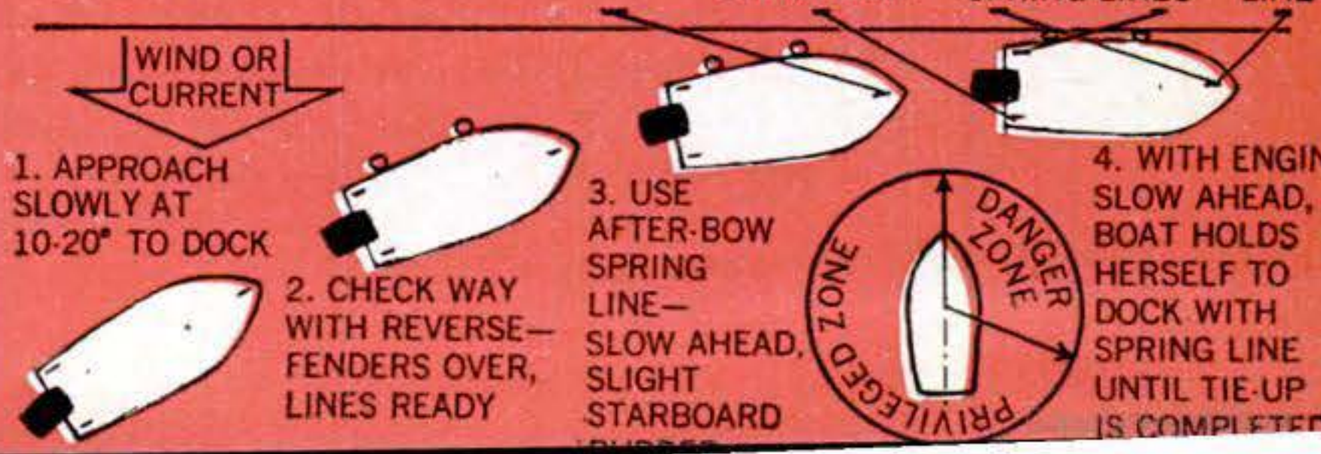
- If you have an electric-starting motor, record the key number in your owner's guide. If your key is lost, you'll be able to get a replacement faster by referring to the key number.
- Take your trailer to a vacant lot and practice backing it. The rule is: Turn the wheel of your car left to make the trailer go right, and vice versa.
- When you're a whiz at backing a rig, apply the same diligence to learning to dock your boat properly. (Hang fenders over the gunwale to protect your boat if the dock isn't well padded.)
- Enroll in a class on handling small boats. The U.S. Power Squadrons, Coast Guard Auxiliaries, and others offer such courses on land and at sea.

Start slowly. Save the overnight cruises for later, when you're at home with your rig. And keep things in perspective; you'll master the new-boat jitters after a few outings, as millions have. PS

Powerboat handling—trailering to docking

Trailering a powerboat takes practice—do it in a vacant lot before backing down a ramp into the water. You may need a registration number for both your boat and motor. Read your warranty, and go through your boat's manual thoroughly to take a lot of kinks out of your first 30 days. It tells you in simple language what you need to know. Be sure to see your insurance agent about boat coverage. The sequence of drawings below shows you the proper procedure for docking. In the circle at far bottom is shown zone of privilege and where there may be danger.





The 16 Most-Asked

Every year, thousands of our readers buy the

By JIM ROE / *PS Boating Editor*

About to get started in boating, but have some unanswered questions? Step right up and ask 'em!

Don't be afraid of being branded a neophyte. The more a man learns about boating, the more questions he knows how to ask. Friends, even strangers, who own boats will be glad to help you find the answers you need. Dealers and manufacturers of boats and equipment are also happy to share their knowledge. PS can help, too. Our experience indicates that your questions will include at least half of these:

Q How do I know whether I would prefer power or sail?

A This is like asking yourself whether you prefer blondes or brunettes. You just *know*. Poke around a boatyard a few times and you'll find that one type of boat, and probably one specific boat, will talk to you. Of course, boats offer you one big advantage over blondes and brunettes: It's quite all right for you to have *both* a power boat and a sailboat!

Q What size should I think of when I buy my first boat?

A Don't be afraid to start small. My first boat was a 16-foot canoe, and I wouldn't have missed it for the world. Boating pleasure does not necessarily increase in direct proportion to the length of the hull. I always recommend buying the boat you can comfortably afford. That way, boating can continue to be pure fun.

Q I've been trying to decide whether to buy a riding horse or a boat. People tell me the waters are getting crowded. Is there still any room to get away from people with a boat?

A Lots of it. So much, you'll do well to learn a little navigation to avoid getting lost. For real solitude, better settle for the boat. Whoever heard of anybody needing a compass on a horse?

Q Which is best for you—a new boat or a good used one?

A Suit your psyche. A good used boat is often every bit as satisfactory as a new one. In fact, some used boats are better than new since they come with handy equipment already installed. And buying an "experienced" boat is a good way to get started in boating with a smaller investment.

Q Does a boat hold its value well, or will the new boat I buy be worth little or nothing a couple of years from now?

A Well-tended boats hold their value well. They'll sell for less than a new one, of course, but a boat of known and recognized quality, which has had good care, will be a very saleable item when you want to trade up.

Q Okay, then, how do I select a really good used boat?

A Simple. Select a good dealer. Then take his advice. He'll want you a satisfied and happy customer—a repeat customer. The best boating investment you can make is to invest in the experience of a knowledgeable boat dealer.

Q Is boating only for the rich? What does it cost to get started?

A In spite of inflation, the answer I gave to this same question back in 1963 is still true. There are about eight million boats in the country, and there aren't that many rich men. You can get into boating for any figure from $50 up.

Q Be specific. What kind of boat can you get for $50; and how much is a stern-drive or outboard runabout?

A You can still get a good secondhand canoe or skiff for $50. For a hundred or two, you can get a small sailing craft. For a thousand to $1,500 you can buy a 14- to 16-foot runabout with a motor of moderate horsepower. For an 18- to 20

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Questions About Boating

first boat. Here are the 16 points they ask PS about most often

foot family boat with a big outboard motor or adequate stern-drive power, you're talking about anywhere from $3,500 to $5,000.

Q Wood, aluminum, or fiberglass? Which should I buy?

A The big swing is unquestionably to fiberglass in runabouts, and to aluminum in fishing boats. The obvious advantage everyone is seeking: less maintenance. But buy what appeals to *you*. Part of the pleasure of boating is esthetic. I have owned a succession of wooden boats, and have found it not at all difficult—even fun—to supply the occasional coat of paint they need.

Q Another question of choice: Inboard? Outboard? Or stern drive?

A Here again, there are strong trends. There is a big trend toward the stern drive in runabouts from 15 through 25 feet. But at the same time, the number of new outboard motors continues high. Though the big boats—30 feet and over—continue to be straight inboards, the inboard engine coupled to a stern-drive unit has fulfilled its promise, providing the advantages of inboard power with those of maneuverable, outboard stern propulsion. For fishermen, of course, nothing can challenge the outboard. And if you wish to update your boat or motor frequently, the big and lively outboards are the answer.

Q Would you recommend buying a trailer for the boat, too?

A Yes. You'll want to sample water in several locations. A trailer is a boatman's magic carpet. Get one, and make sure it's plenty large enough to haul your boat and all the miscellaneous gear you'll put in her.

Q How about the new dry marinas? Are they worth using?

A If there is one near you, use it. In these installations, your boat is stored inside a building on a cradle, or perhaps on its own trailer. And it's put in and out of the water for you mechanically whenever you wish to use it. They are very popular in Florida, and are spreading across the country.

Q There are lots of new hull shapes. Any advice on that?

A Yes, indeed. I personally like either a classic round-chine hull, a good deep-V, or one of the large family of new multikeel hull designs.

Q I'm strictly a landlubber. Where can I learn boat-handling skills?

A No trouble. First, ask your dealer to give you a few tips and a little on-the-water instruction. Next, spend as much time as you can reading magazine articles and books on seamanship techniques. Join your local Power Squadron and take the seamanship course. Go down to the harbor and watch the experts handle their boats. And practice, practice, practice.

Q Is boating really as much fun as boatmen make it sound?

A Even more. And it's one of the few sports you can enjoy with your family. Not only that, you can enjoy boating along with other hobbies—swimming, camping, photography, and for weekend mechanics and craftsmen, maintenance is fun. Take a look at "26 Ways To Have Fun Afloat" a few pages further on.

Q But I live in dry country. Water is a long way away. Is there any sense in my owning a boat?

A You bet! Water is never that far away. I once had a friend who lived in arid West Texas. "I live right in the heart of the lakes country," he'd say. "There is one lake just 400 miles to the north, another 600 miles south, and over to the east . . ." So no matter where you live, get a boat and head for water. I'll guarantee you'll be glad you did.

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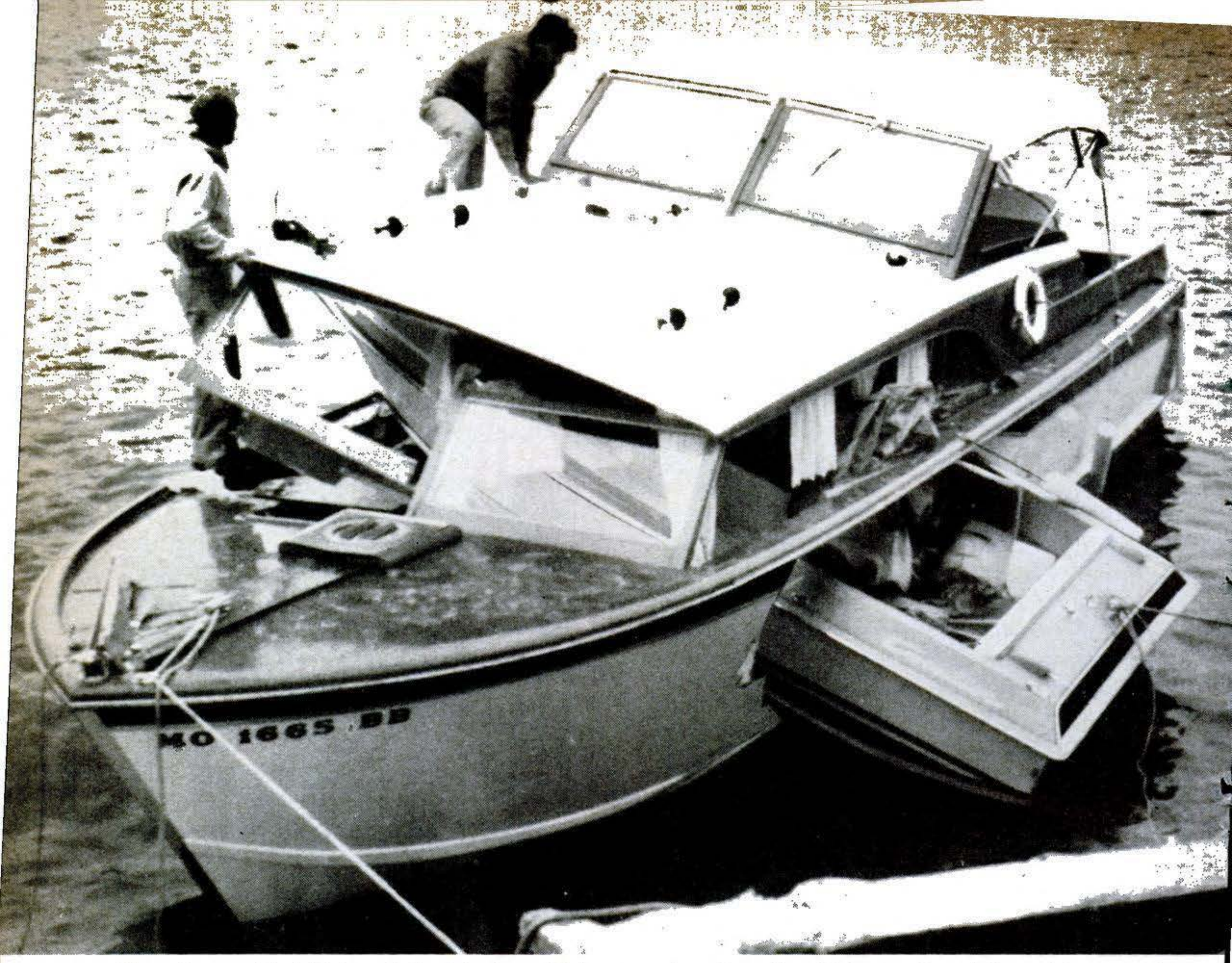

Observing nautical Rules of the Road would have averted this tragic and almost unbelievable collision. Speeding 16-footer plowed through larger craft like a missile, killing one person and injuring 11.

Rules-of-the-Road Reminder

This chart-table aid will tell a pleasure-boat skipper who has the right of way afloat, and how to exchange signals with other craft

By ERNEST A. ZADIG

Why boatmen should observe the nautical Rules of the Road is emphasized by the photo above. The law requires obeying the Rules—but your life, and the lives of others, are more basic reasons.

The U.S. Coast Guard devotes three whole booklets totaling 248 pages to describing the Rules. But they boil down to a few simple procedures that become second nature to a pleasure-boat skipper. Learning them is made easy by a "Rules-of-the-Road Reminder" for your chart table, reproduced here in assemble-it-yourself form. (A ready-made manufactured version is available, for $1 postpaid, from The Pilot House, P.O. Box 561, South Norwalk, Conn. 06856.)

Under the Rules, boats approaching a potentially dangerous confrontation are either "privileged" or "burdened."

If you are "privileged" you have what a landlubber would call the right of way. But you also incur the obligation to hold your course and speed, to relieve the

[Continued on page 188]

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Based on "Rules of the Road: International, Inland," U.S. Coast Guard, CG-169, 9/1/65.

ONLY when other boat is coming HEAD-ON, or nearly so, in yellow segment:
YOUR BOAT: Swing to your right. YOUR SIGNAL: One blast. OTHER BOAT: Swing to his right. HIS SIGNAL: One blast. Boats pass left side to left side. EXCEPTION: If other boat already so far to your right that SAFER to pass right side to right side, SIGNAL TWO BLASTS, pass right side to right side.

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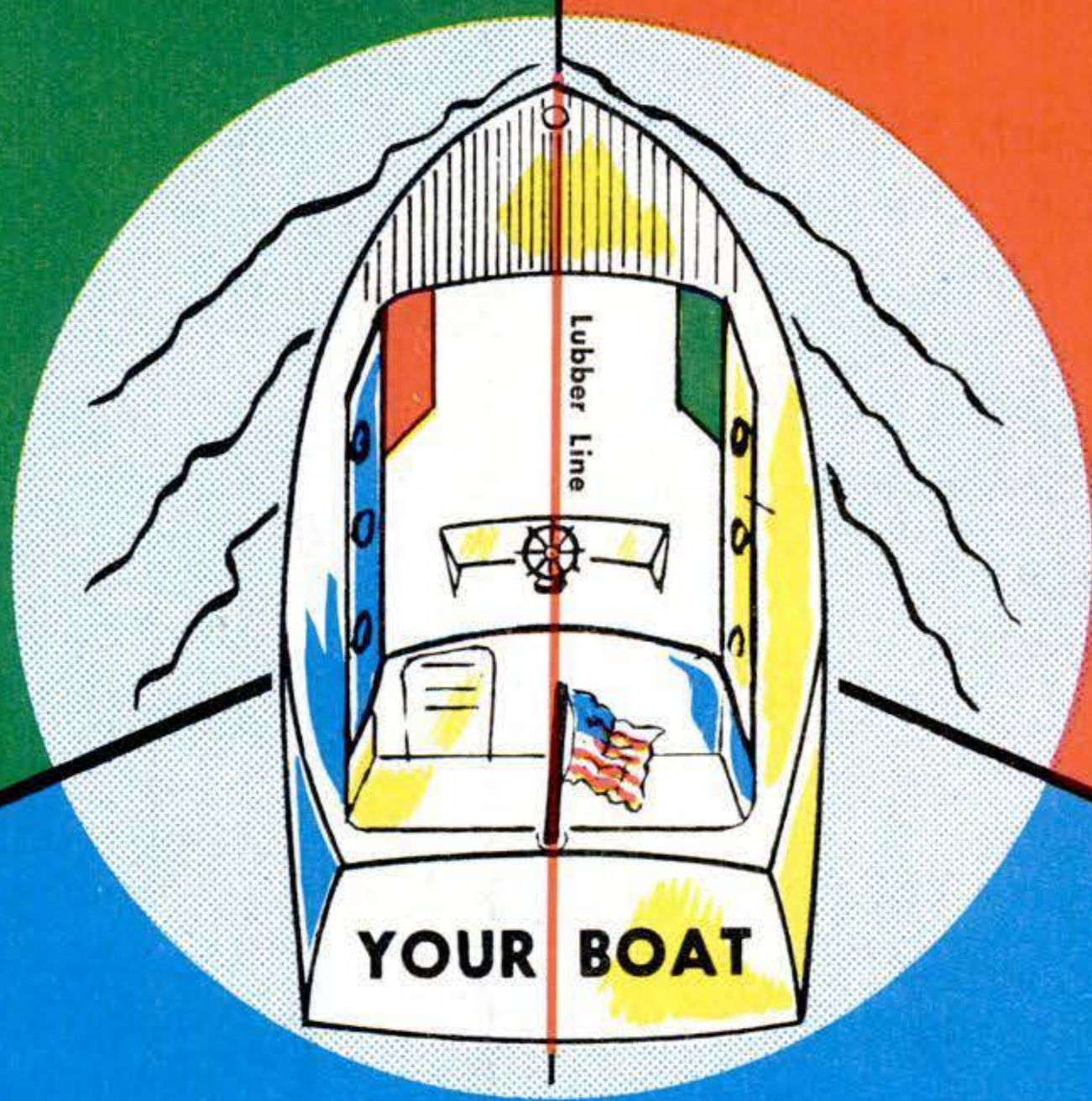
South Norwalk, Ct.

YOUR BOAT: Maintain course and speed. YOUR SIGNAL: One blast. OTHER BOAT: Must keep clear and pass astern of you. HIS SIGNAL: One blast. Your boat is PRIVILEGED in this green segment. This means maintain course and speed but in extraordinary circumstances you must co-operate to avoid collision.

YOUR BOAT: Keep clear and pass astern. YOUR SIGNAL: One blast. OTHER BOAT: Maintains course and speed. HIS SIGNAL: One blast. Your boat is BURDENED in this red segment. This means keep out of the way by slowing, stopping or reversing. Avoid crossing ahead of other boat.

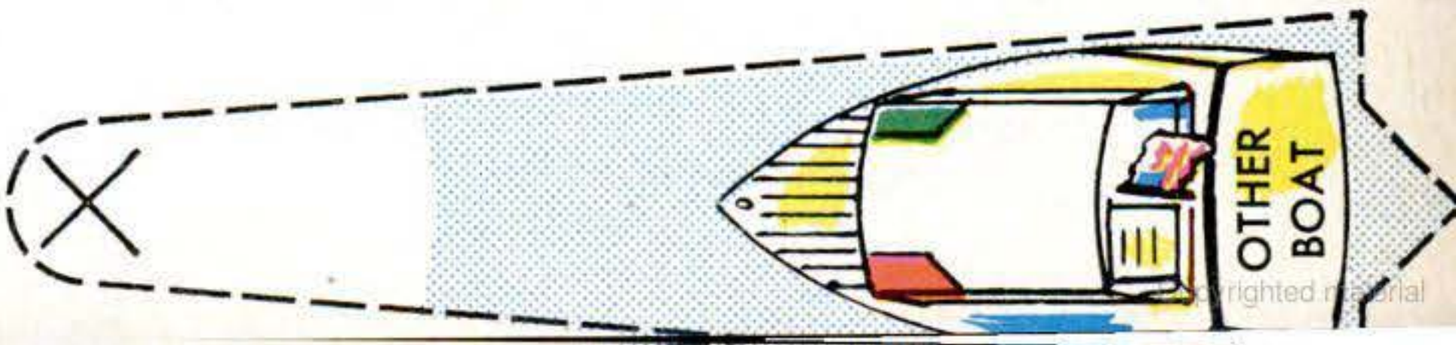


OTHER BOAT: Wishing to pass you on your right side signals one blast; on your left side signals two blasts. YOUR BOAT IS PRIVILEGED. If you consider passing SAFE, repeat his signals. IF NOT SAFE, SIGNAL FOUR BLASTS. Other boat is overtaking you in this blue segment.

OW TO USE THIS SAFETY AID: 1. Lay Rules of the Road Re-inder flat on the chart table so that "your boat" on the card pointing in the direction your boat is moving and the "lubber line" is exactly parallel to your keel. 2. Turn "other boat" on the card until it is in the exact position of the actual other boat which is approaching you. 3. Follow directions for the segment.

Use whistle signals only (and always) when you can see other boat. Use fog signals in no-visibility weather when you can't. SAILING BOATS **UNDER SAIL** have the right of way. If you are going ASTERN signal THREE BLASTS.

his assemble-it-yourself "Reminder" is an actual-ize reproduction of manufactured version costing a ollar. To use it, mount parts above and at right on iff cardboard and cut along dotted outlines. Attach Other Boat" piece to larger one by putting pin or umbtack, which serves as pivot, through cross on rmer and into steering wheel on latter.



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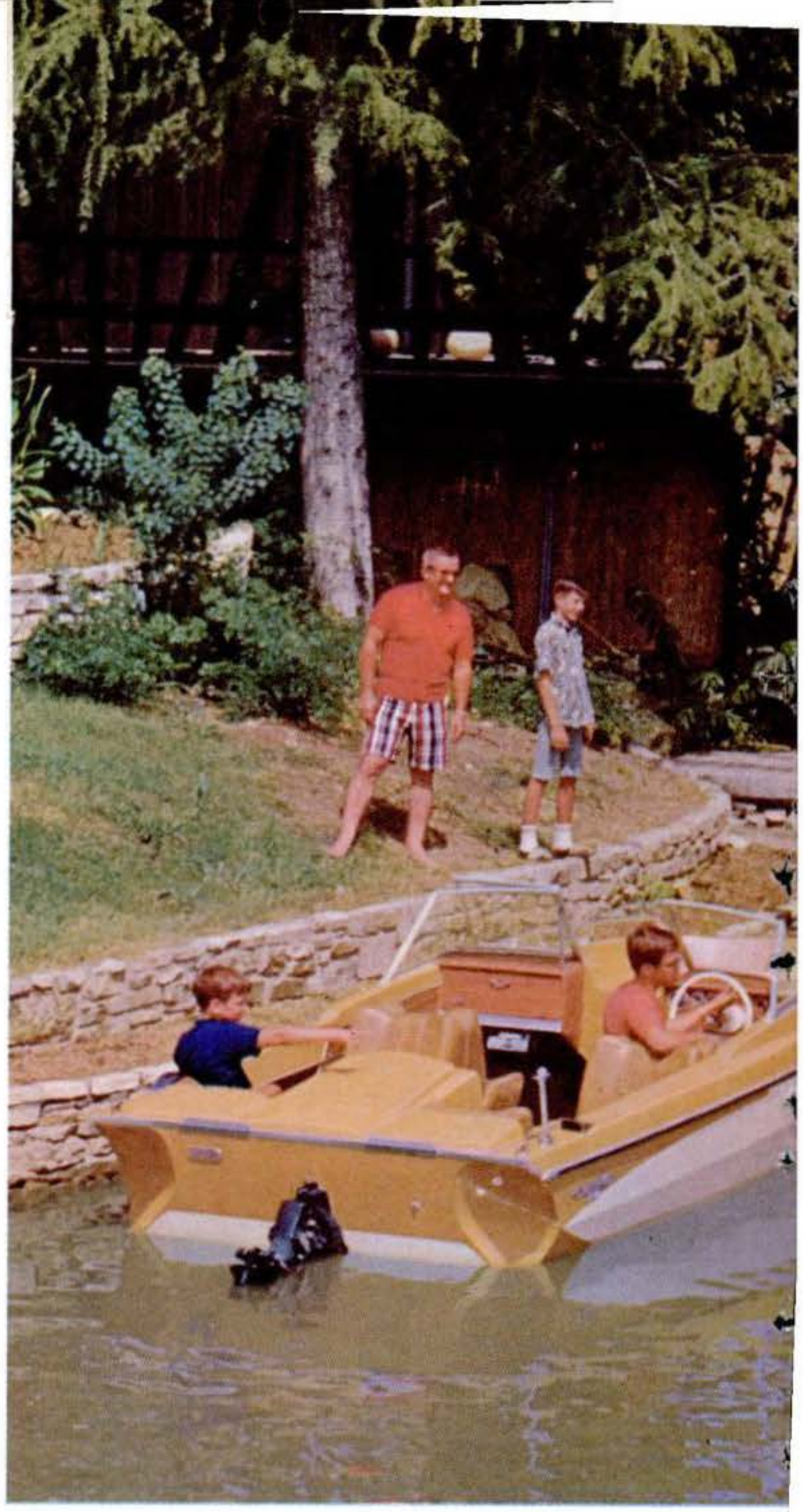
26 Ways to Have Fun Afloat

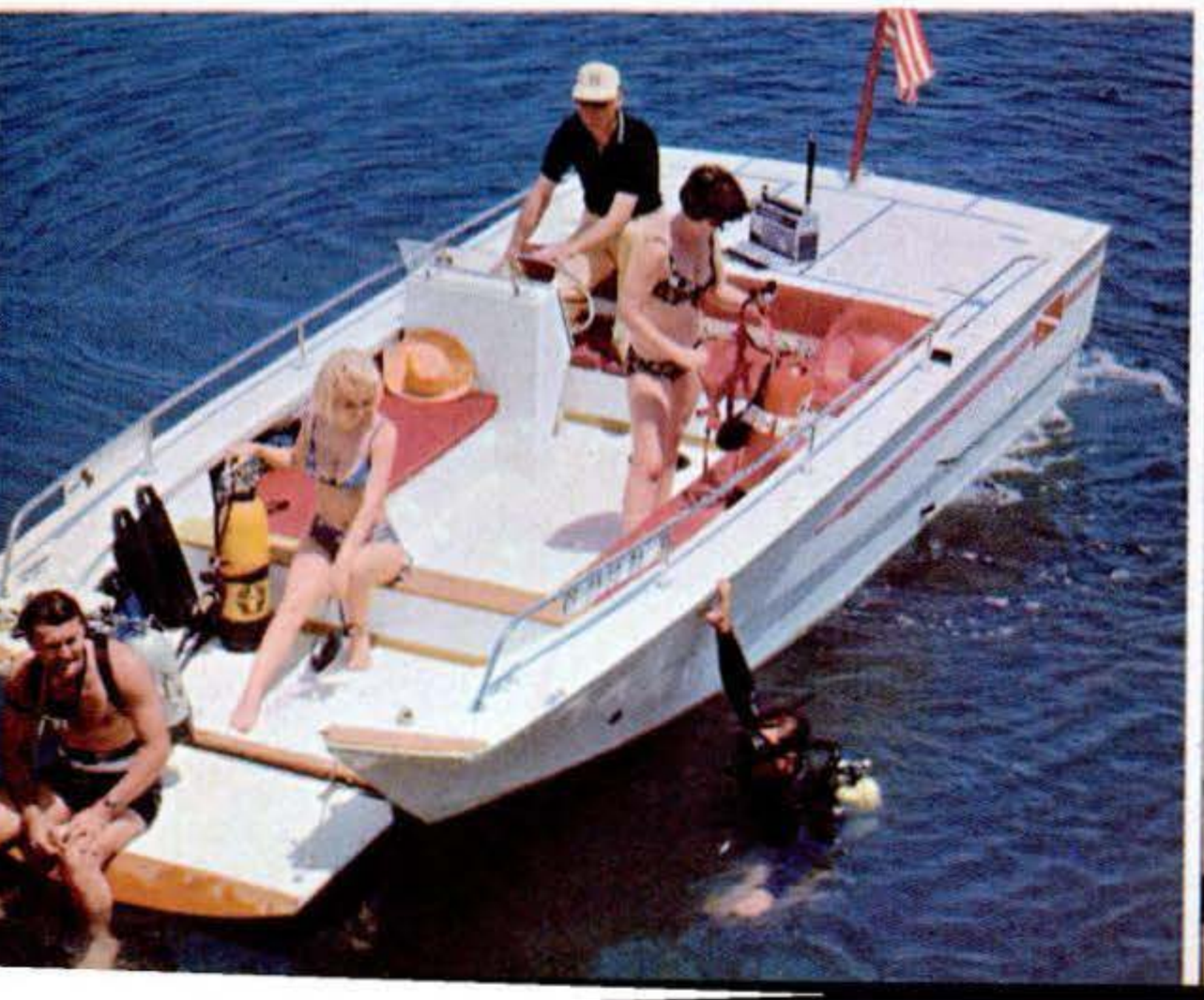
Why own a boat? There's just one reason: To have fun! But there are hundreds of ways to have fun with today's well-designed, well-equipped, colorful craft. Here's a preview of '68 boats and motors

By **JIM ROE** / *PS Boating Editor*



HAVE A "BOAT-IN." *That's what this gang is*

DIVE! DIVE! *Century's new Trident was designed for the scuba diver. Bow ramp lowers for easy exit, reentry. Fishermen have discovered this roomy boat, too.*



SLALOM. *Want to cut a pretty figure on the water? Evinrude's three-cylinder, 55-hp. outboard helps you get on the top, has power for you to have a friend alongside.*

Doing with a Nautaline houseboat, three '68 Glastrons. In center, the hot, new GT-110.

CATCH 'EM. *The fish won't get away, but you can in Aluma Craft's aluminum fisherman. It's easy to car-top or launch, stable afloat. Evinrude outboard powers it.*

CAMP OUT. *At least half the fun of fishing is the relaxation. All you need is a sturdy boat and a lightweight motor like the 9.8-hp. Mercury 110.*

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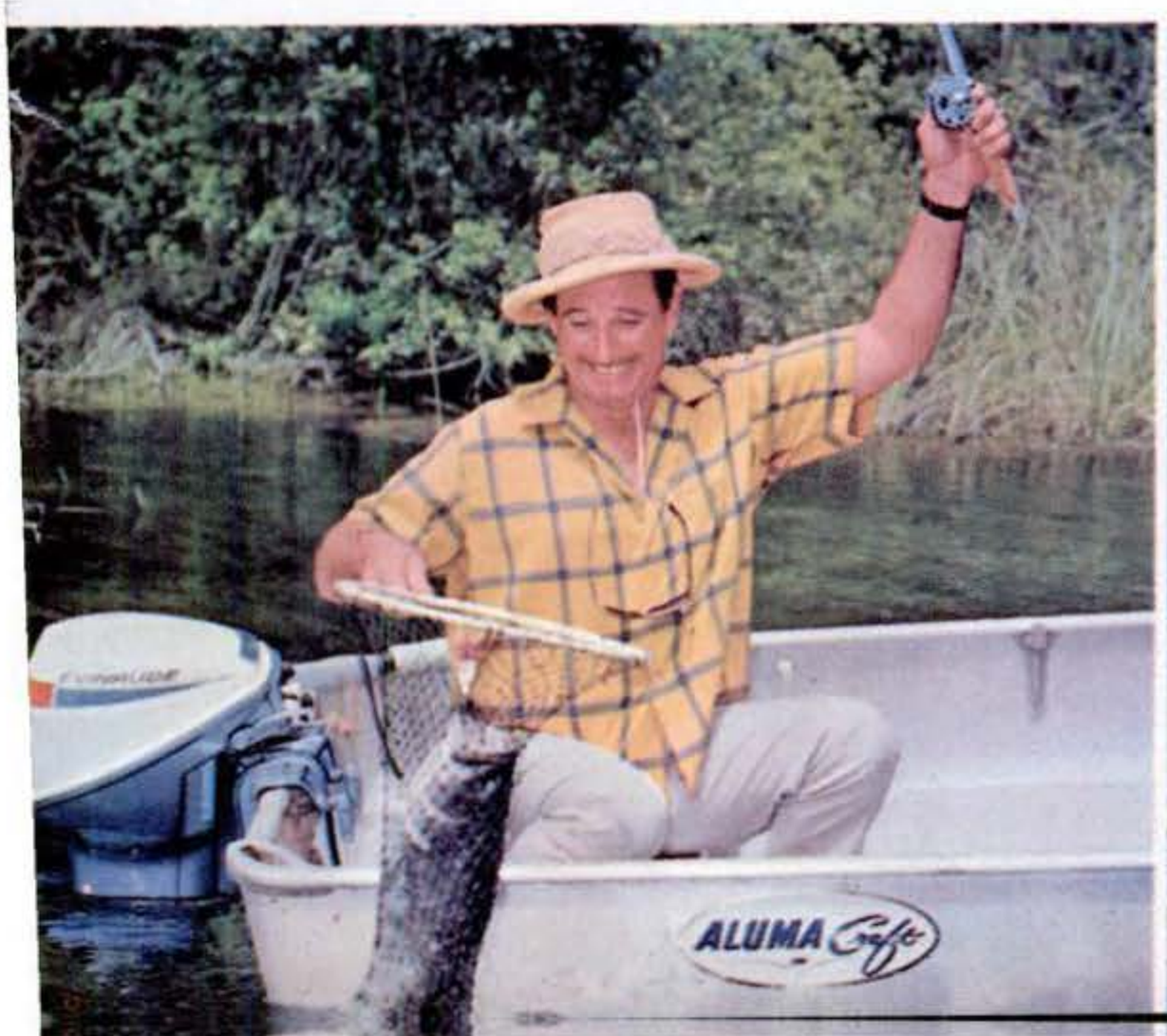

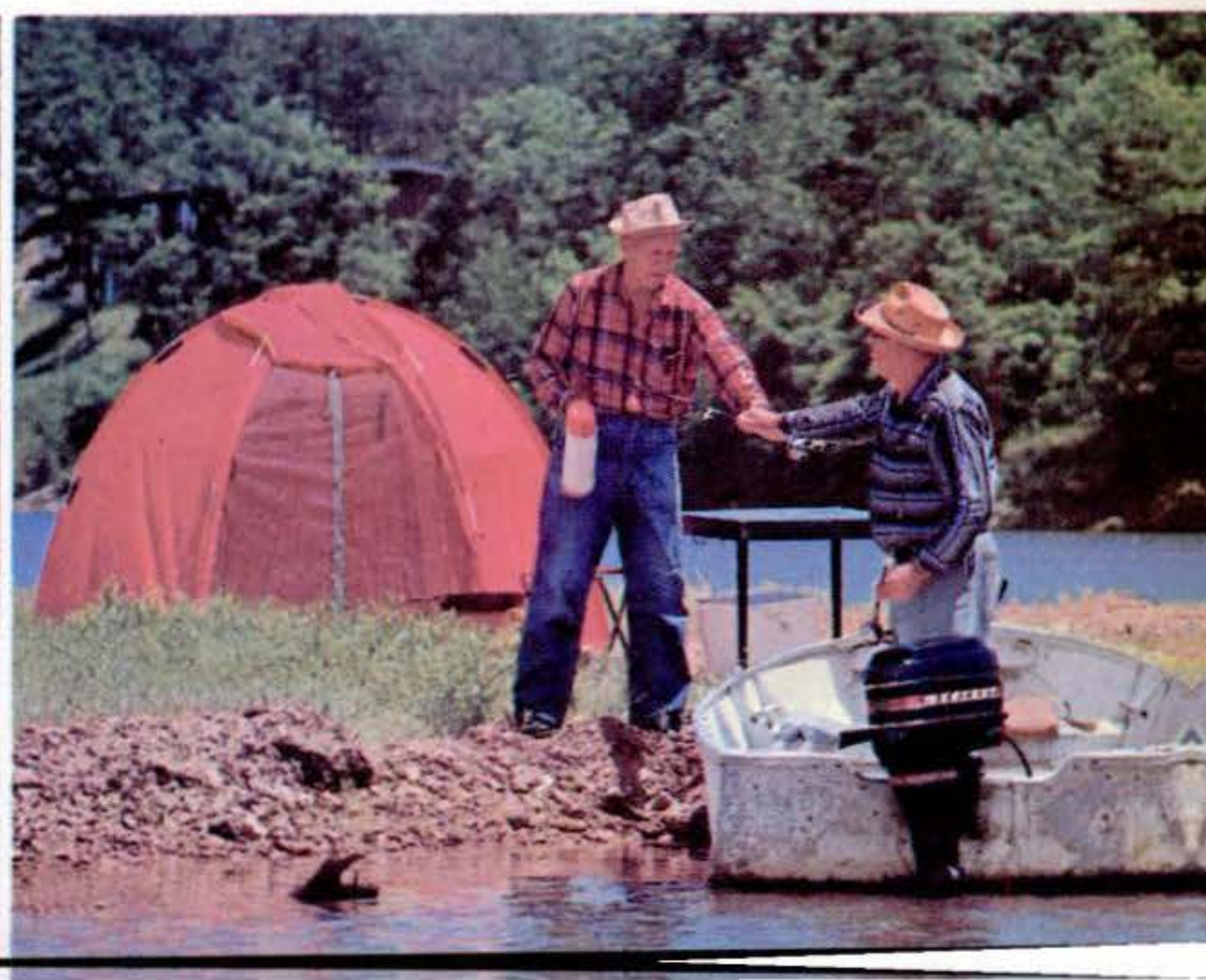

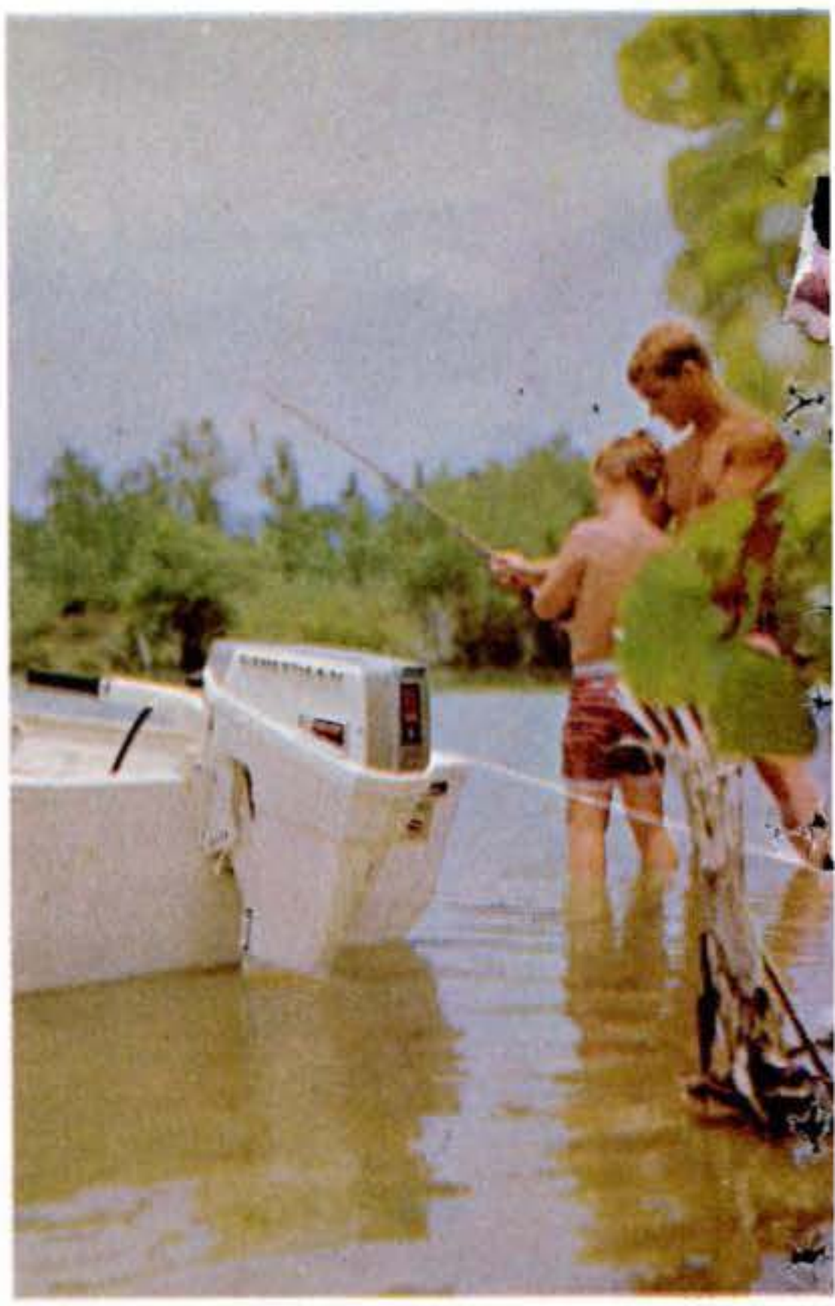

SHARE. *For father-son fishing, Chrysler offers eight new fishing-size outboards for '68. Above: the nine-hp. unit.*

GO DEEP-SEA FISHING. *A Stamas hull, powered by a pair of 200-hp. OMC sterndrive units, will take you out.*

GET AWAY. *Leave the crowded beaches to the landlocked non-boatmen. Hunt your own swimming hole with a Glasspar, propelled by an OMC stern drive.*

RACE. *New three-cylinder, 55-hp. Johnson sends a special racing hull skimming toward the finish line. The unit features loop-charge scavenging for higher hp.*

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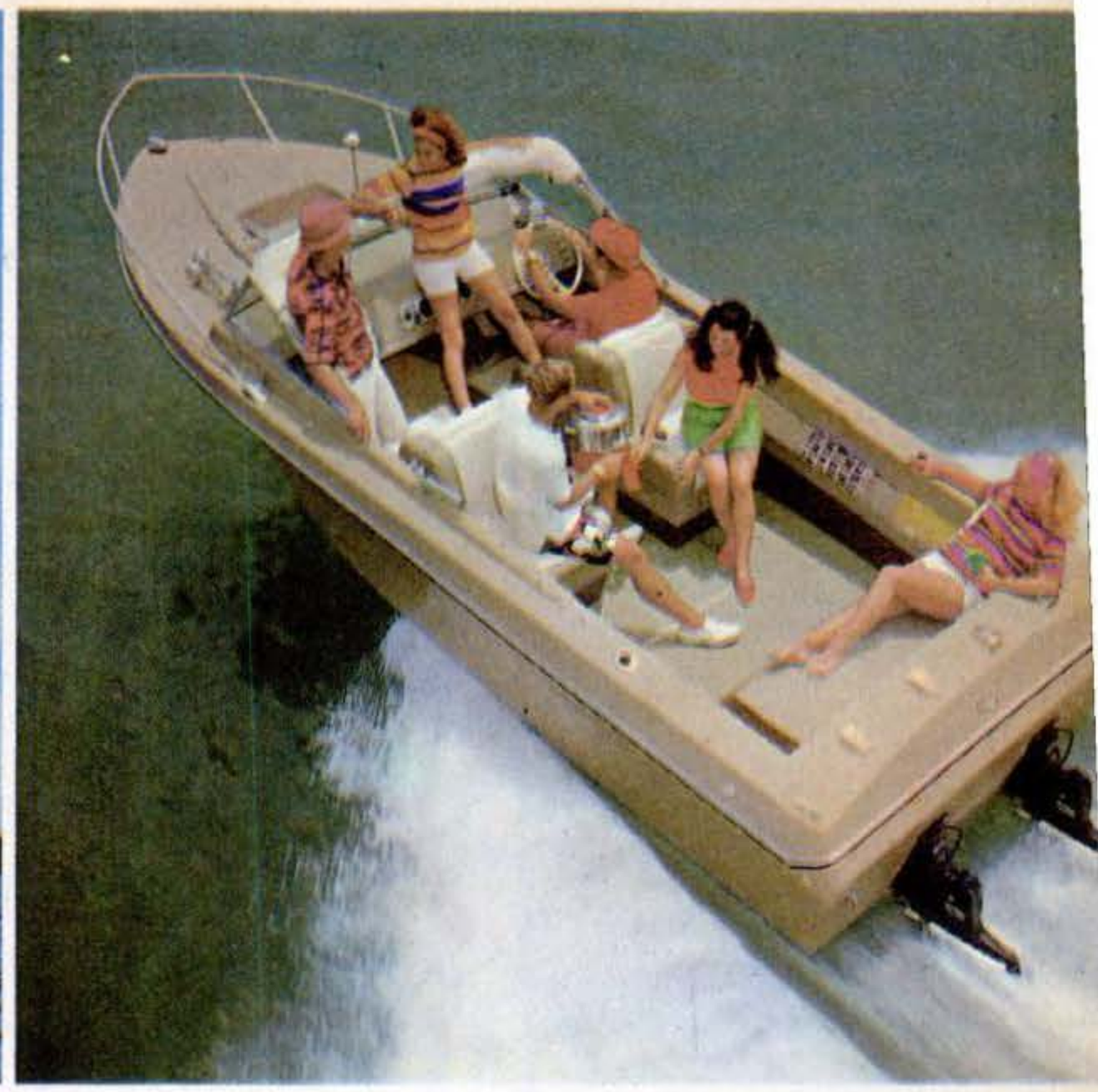
PARAGLIDE. *Try this new water sport. Ingredients above: one venturesome parachutist attached by a long line to new Larson 18-foot All American 186 outboard.*



ENTERTAIN THE GANG. *There's plenty of room for friends aboard the '68 Viscount by Winner. It's powered by a pair of fast-stepping 80-hp. MerCruiser stern drives.*

LIVE ABOARD. *You can, since all the comforts of home are in the new 40-foot steel-hulled River Queen. Sleeps six. Goes 30 m.p.h. with twin 210-hp. Chryslers.*

CAMP ABOARD. *You don't even have to pitch a tent when you have this MFG Carousel Camper. The boat is powered by a MerCruiser stern drive.*

PLAY. *Versatile Sportyak costs less than $100, can be rowed, sailed, or operated with small outboard. Handy as a dinghy.*

SHOOT SKEET. *With the 36-foot '68 Chris-Craft Crusader, it's easy to go offshore to your own shooting preserve.*

Continued

RIDE THE WIND. *This handsome Ray Greene centerboarder is just one of many sailing models available for '68. You've never sailed? Learning how is simple, yet you can spend happy decades at the sport and still be learning new tricks.*

GET AWAY FROM IT ALL. *In just a few hours you can haul a car-topped boat such as this Crestliner to a distant and quiet stream.*

TAKE YOUR HOME ALONG. *Big, new Sunliner lets you do just that. This houseboat is a great favorite for exploring rivers and lakes.*

EXPLORE THE DEPTHS. *Take a fast cruise to your favorite exploring area aboard the '68 Evinrude Sportsman 155 gull-wing. Once there, launch the Aquanaut diving and air-supply unit for your frogmen. Floating compressor supplies fresh air.*

RELAX. *Pick a good friend, a quiet pool, and commune with the fish. Get there with one of McCulloch's family of '68 fishing motors.*

HAVE A HAPPY FAMILY DAY. *One of the joys of boating is that all ages can enjoy it together, as a family — especially aboard this Starcraft with 120-hp. stern drive.*

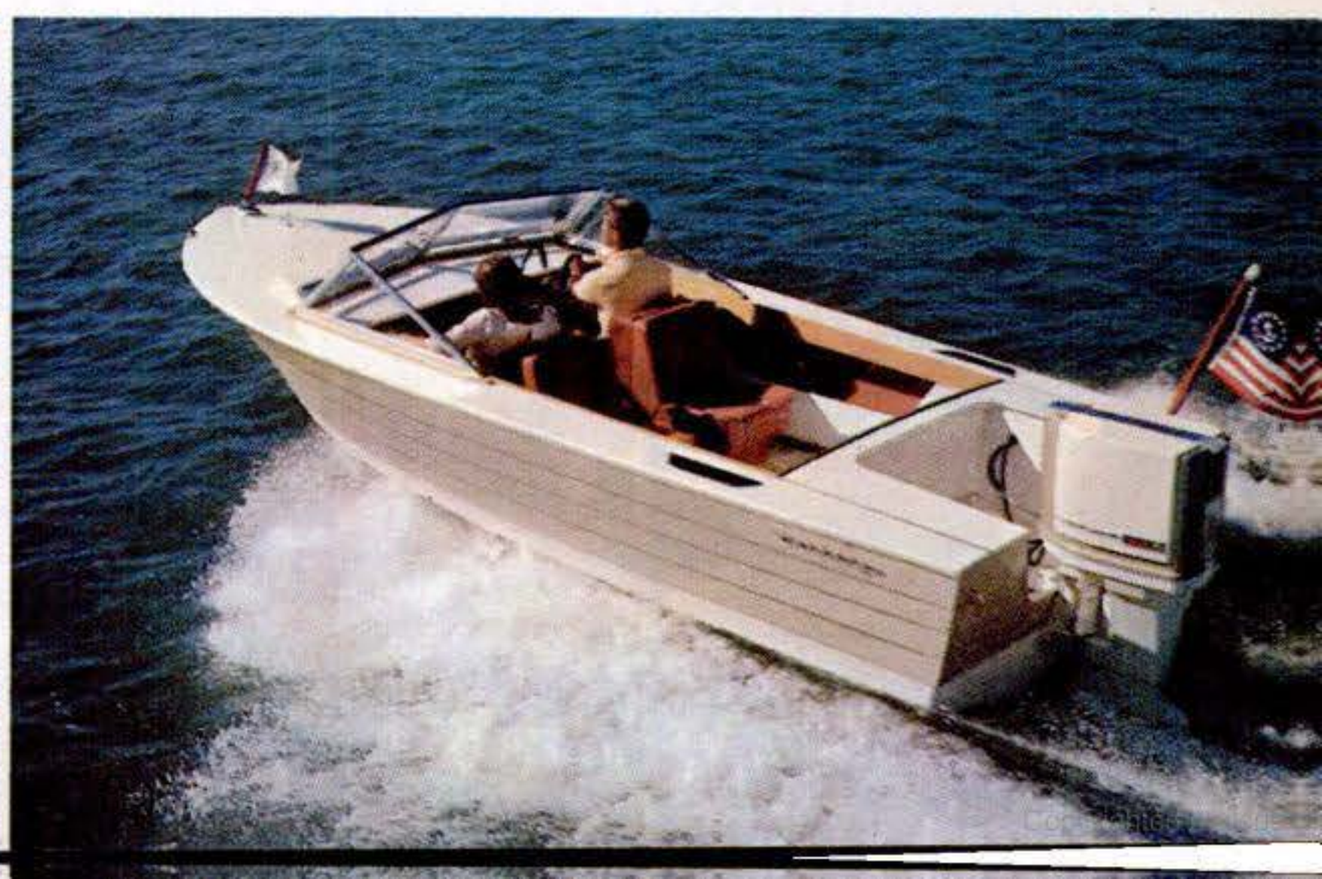
TAKE HER CANOEING. *What could be more romantic than a quiet ride in this most classic of all boats? This aluminum Grumman is sturdy while light in weight.*

SPEED IN STYLE. *Snazzy new Boss by North American is a fiberglass sports car afloat. Power is a high-horsepower OMC stern drive. Nothing like it for whoosh.*

JUST TAKE A RIDE. *This is one of the most enjoyable aspects of boating. The 18-foot Shell Star shown is powered by a Merc outboard. Stern drive is also available.*

MIX KIDS, DOGS, WATER. *A surefire formula for a great day. Homelite's 1968 four-cycle outboard gets the whole crew out and back with dependability, safety.*

DATE. *And what better way to entertain that date than with a speedy spin in this big Century lapstrake runabout? It's powered by a 105-hp. Chrysler outboard motor.*



Gus put the car on the lift and listened as he turned the wheels.

Gus and the Case of the Car

The Model Garageman seeks the answer to an automotive puzzle that's strictly for the birds

By MARTIN BUNN

"GUS Wilson! How fortunate—there was something I had to see you about."

Gus turned on the coffee-shop stool to face the small, bearded man, a member of the local high-school faculty.

" 'Morning, Mr. Lessing," he said. "Cutting a class for coffee?"

"I don't think so," returned the other, taking a notebook from his pocket and hastily leafing through it. "No, I'm free now. I want to pick up a book I ordered and—yes, here it is—to tell you about Paul."

"Paul?" asked Gus, sipping coffee.

"My brother," said Peter Lessing. "He's on one of his recording trips, and stopped to see me, as usual. There's some trouble with his car, so I sent him to you."

"I'm going back to the Model Garage soon as I finish here. What instrument does he play?"

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ILLUSTRATION BY RAY QUIGLEY

That Chirped

"Instrument?" Lessing peered at Gus in amazement. "Oh, he's not a musician. My brother is an ornithologist, perhaps this country's foremost authority on bird songs.

"This car difficulty is most serious. It is ruining his ears, which, of course, are highly trained and sensitive." The little man looked sternly at Gus, his eyes owlish above a large, beaklike nose. "I am merely a teacher of biology. My brother is a maestro of nature's melodies."

"Well, I sure will help all I can," promised Gus. "Is there anything else on your mind?"

"Let me think," pondered Lessing. "It was something about my wife . . ."

"Maybe you better phone me," suggested Gus, swallowing his coffee. "What did you say's wrong with your brother's car?"

"It chirps!" said Lessing.

As Gus drove up to the Model Garage 10 minutes later, a Plymouth emerged from the shop and drove down the street. If Gus hadn't just left Lessing, he would have sworn it was he driving.

"Well, Stan," said Gus to his assistant on entering. "Did you get the bird out?"

Stan stared at him dumbfounded.

"A guy I've never seen comes in here 15 minutes ago, complains his car chirps like a bird, and when he drives out you come in as if you know all about it!"

"His brother told me. No sweat, huh?"

"The drive-shaft splines were dry," said Stan. "Soon as the grease I put in works through, the squeaks ought to stop."

An hour went by. Then a car horn demanded entrance. When Gus raised the door, the Plymouth drove in, announcing its progress by a series of chirpy squeaks.

Apparently the Lessing brothers were twins, though this one lacked the beard and wore a hunting hat and carried binoculars instead of the book bag Peter Lessing affected.

"It's unbearable," began Paul Lessing. "My ears are throbbing. I may never hear properly again. I believe I heard a house finch this morning, but before I could stop, a cardinal answered this car's abominable chirps and the finch vanished."

"Suppose you take a chair," suggested Gus. "I'll drive the car and listen."

"Thank you. It will be a relief."

Gus got into the Plymouth, the back of which was loaded with tape recorders, microphones, and other equipment. A slow squeak began before he was out of the shop, becoming a rapid *chirp-chirp-chirp* as the car gained speed. It seemed synchronized with wheel rather than drive-shaft rotation. Applying the brakes had little effect on it. Even without particularly sensitive ears, thought Gus, a few miles of driving to that sound could be maddening.

Back in the shop, Gus put the car on

Continued

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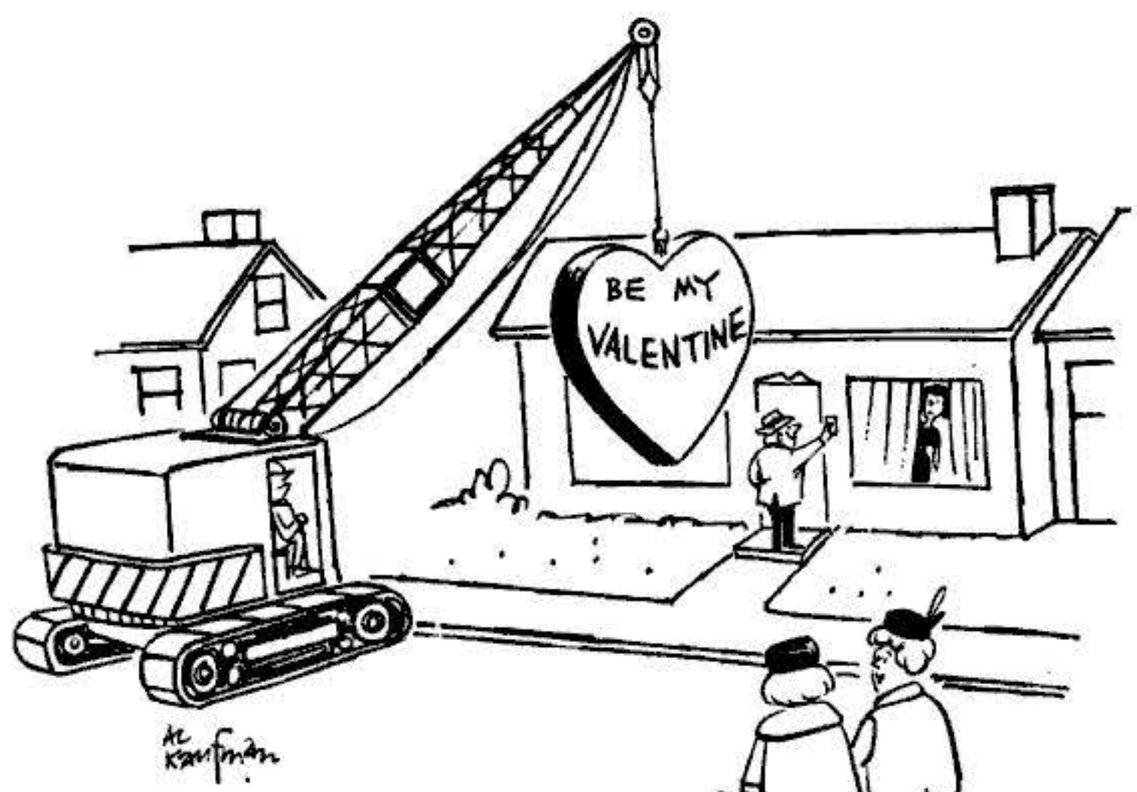
a body lift, the wheels hanging free. He turned them, listening for the click of a defective bearing, the drag of brake lining, or the squeak of out-of-round drums. None of these was evident.

"I should tell you," said Paul Lessing, "that one mechanic wanted to install new brake lining, and another a new drive shaft. But either would have delayed my trip. One man said the antisqueak spring on a brake drum was missing or broken, but on checking confessed himself mistaken."

Gus lowered the car enough to get into it, started the engine, and ran the wheels briefly under power. There was no noise.



"She always said she wanted a man who thinks big."

"Fine! The chirp's gone," said Lessing.

"Not really," said Gus. "I raised the car to check some things that might show up that way. Others wouldn't. The wheels and suspension aren't loaded with the car on the hoist, nor is the body subject to road stress. That makes a difference."

Dropping the car to the floor, Gus drove it off the hoist a few feet. It chirped. Lessing covered his ears.

On the garage floor, Gus thought, there was hardly enough body movement to cause a door or hood squeak. But the weight of the car came into full play. Getting out, he looked at the wheels for a long minute, then proceeded to take off all four of the full wheel covers, unsnapping the serrated edges that gripped the wheels. Laying the covers aside, he drove the car out again.

Around the block he drove, chirplessly. Grinning widely, he reentered the shop.

"Cheer up, Mr. Lessing," he said. "From now on, the birds you hear will all be up in the trees."

Gus rubbed an oily rag around the wheel flanges against which the covers snapped, then put the covers back on.

"You are quite sure, Mr. Wilson?" asked Lessing. "I don't understand."

"When the car's weight is on them," explained Gus, "the wheels flex a bit each time they go around. This causes a little movement between them and the wheel covers where they touch. Both parts being dry, there's a slip-stick action that makes a squeak, which the drumlike metal parts amplify. The oil I put on should quiet the racket by letting the parts slide on each other."

"Wonderful," said Paul Lessing. "I shall seek out that house finch again."

"He's back," muttered Stan when Gus returned from a late lunch. "With a false beard and a different car."

Looking over his helper's shoulder, Gus saw it was Peter Lessing standing beside a 1965 Pontiac.

"Wrong, Stan. It's his brother," whispered Gus. He turned to the customer.

"What is your problem, Mr. Lessing?"

"My wife and I had a disagreement about this car," the little man answered. "Except for my yearly journey to my Biology Association meeting, we use it chiefly around town. But on two turnpike trips recently it began to shimmy distressingly. A friend suggested wheel alignment, so I asked my wife to bring the car here.

"An inveterate bargain hunter, she saw an advertised special and took it to one of those chain service shops instead. They pointed out what they said was a dangerous condition—loose lower ball joints—and said they would not be responsible for alignment or our safety unless those were first replaced, at a cost of $90. As this is what we had budgeted for the Association meeting, my wife says we must forego it to repair the car."

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Chevy II Nova SS

MARK OF EXCELLENCE

The equal to cars known for their looks. The equal to cars known for their road-holding rides. The equal to cars known for their performance. The equal to cars known for their quietness. The very low-priced Nova is a great way to stay equal with people who, for some reason, spend a lot more for a car. So, be smart. Be sure. Buy now at your Chevrolet dealer's.

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from Chevrolet CHEVROLET

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Gus shrugged. "There's a lot of confusion about loose ball joints. Some shops take advantage of it. My twin-post hoist is free, so let's find out."

Driving the Pontiac on it, Gus supported both the lower control arms just outboard of the coil-spring seats.

"This is the only time you'll see any looseness in lower ball joints," he told Lessing. "On the road, spring pressure and car weight holds the ball firm. Here's what they probably showed your wife."

He grasped the wheel at top and bottom and rocked it across its diameter.

"There's less than a quarter-inch of play, so it's within max radial tolerance. But we have to check something else."

Going to the tool bin, Gus brought back a dial indicator, plunger extension, and clamp. He set up the instrument on the steering arm, between the backing plate and tie-rod connection. The plunger extension bore against the underside of the control arm, near the center of the ball joint. With a heavy screwdriver under a backing-plate bolt, he pried straight up. The indicator needle swung around.

"There's 40 thousandths' play," he said. "When it gets to 50 on this car, it's time to replace the lower joints."

The other wheel gave a similar reading.

"Isn't it dangerous?" asked Lessing.

"The *upper* ball joints should be replaced if they show *any* looseness," said Gus. "But the lower ones are compression joints, safe within the specified clearance. Since 1963 a lot of lower ball joints were mistakenly condemned by state inspection stations and mechanics. Thousands of good ones were scrapped.

"Many returned under warranty checked out well within the safe clearance. On later models some car makers reduced that clearance—Cadillac cut it to 20 thousandths—to end such misunderstanding."

"I hope you're saying it won't cost $90," put in Peter Lessing.

"Not for new ball joints," said Gus with a grin. "Wheel bearings are okay, control arms tight. Springs don't seem soft. I'll balance and align the wheels. Your bill ought to be way below that."

That afternoon Gus shifted a cupped tire to the rear, then balanced and aligned the front wheels. Caster proved somewhat excessive. Gus set in the necessary shims to correct it.

In the road test, steering was smooth and self-straightening. No trace of shimmy appeared even at 75 m.p.h. Satisfied, Gus took the car back to the shop.

When Mrs. Lessing phoned, Gus was able to name a reasonable figure.

Just before closing time, Paul Lessing's Plymouth rolled in to the accompaniment of loud chirping.

"Can't win them all, Gus," remarked Stan.

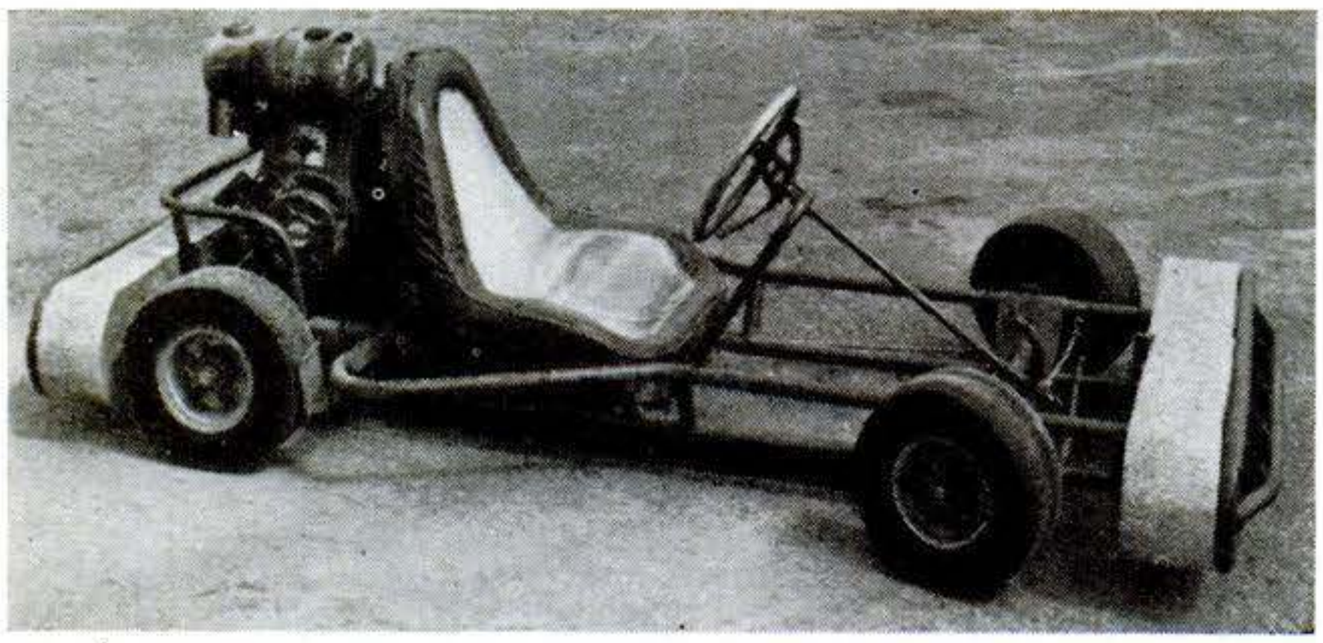
The Plymouth came to a stop. The bird sounds did not. They continued as both Lessings got out, smiling. When the song ended, Paul Lessing reached inside the car and flipped a switch.

"A special rendition for you, Mr. Wilson," said the little ornithologist. "In gratitude for enabling me to record the first song of the house finch in this area."

"And for saving me a considerable amount," put in Peter Lessing.

"You know, Boss," muttered Stan as he closed the shop door, "those splines *were* dry. But they weren't squeaking. How did *you* know it was the wheel covers making like the birds?"

"Guess I was one up on you," replied Gus innocently. "I got a merit badge for bird study when I was a Boy Scout." PS



New bumpers tested on kart

A new shock-absorbent metal—foamed aluminum—is being tried out on an amusement-park kart. Installed behind front and rear bumpers, it's collision-tested as the little vehicle races around the course. Invented by Bjorksten Research Labs of Madison, Wis., foamed aluminum is also under test by major auto manufacturers.

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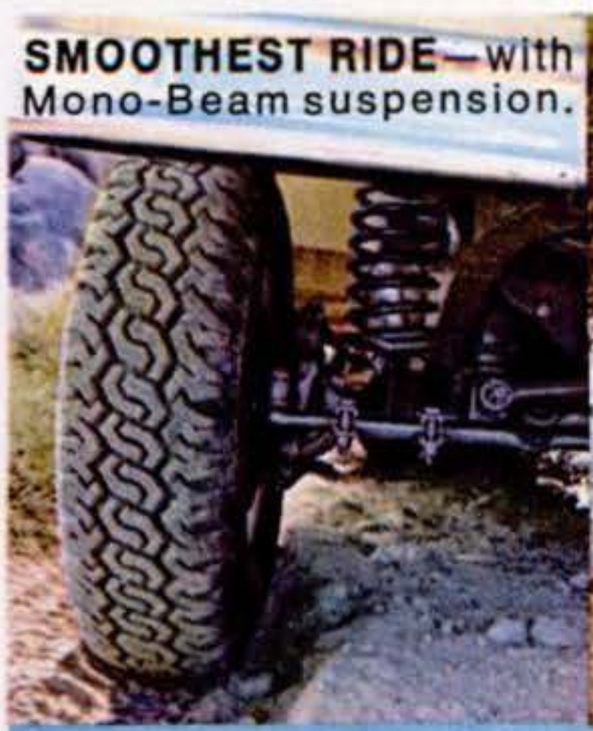

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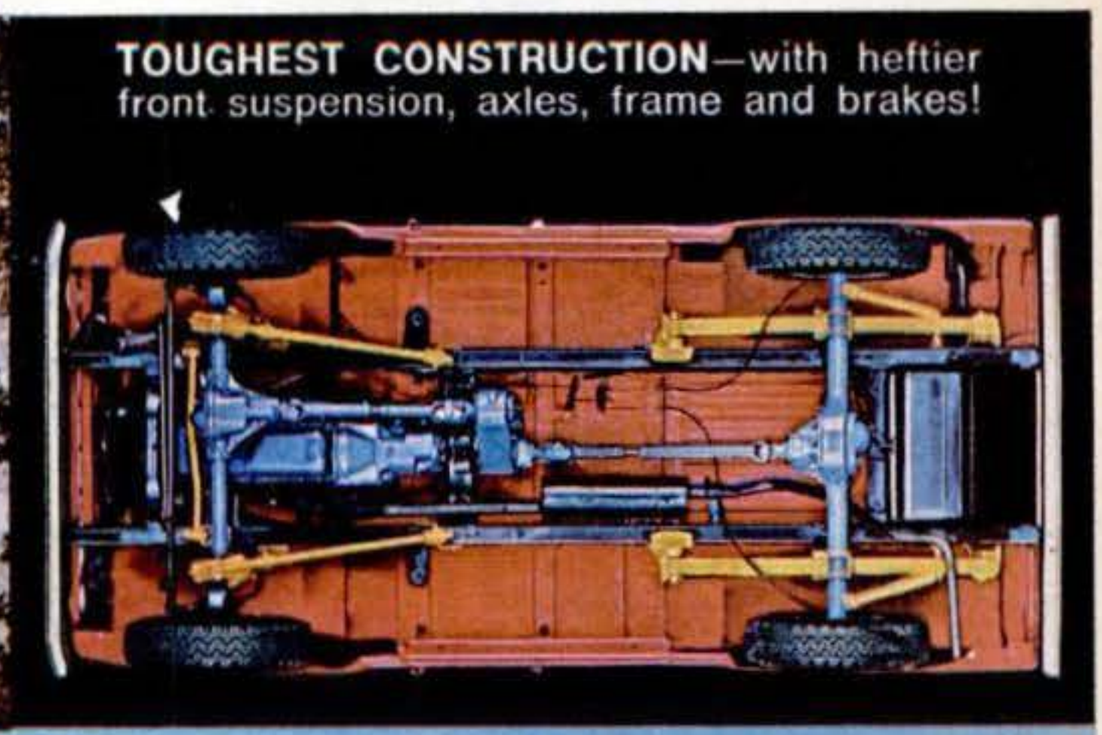

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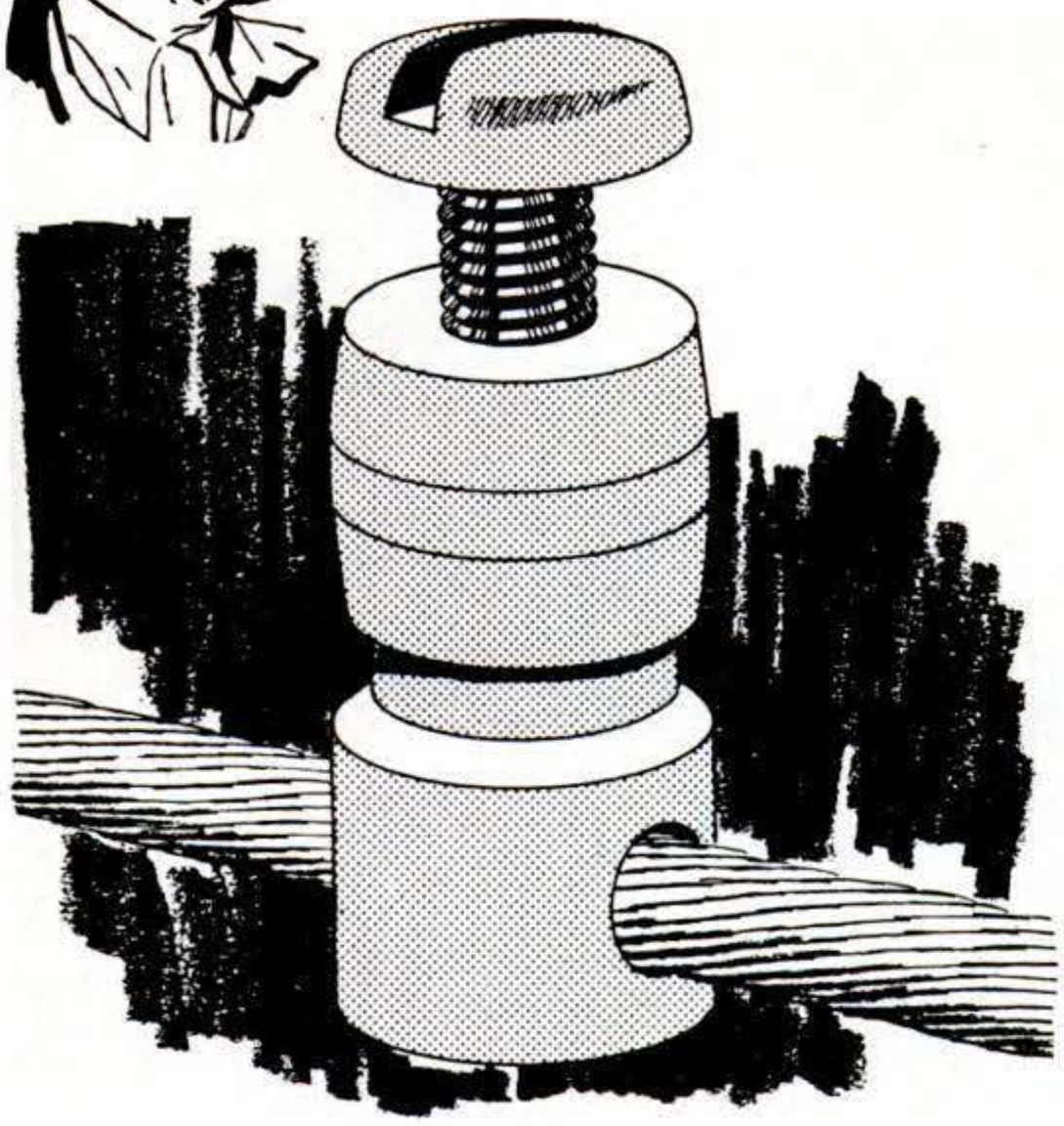
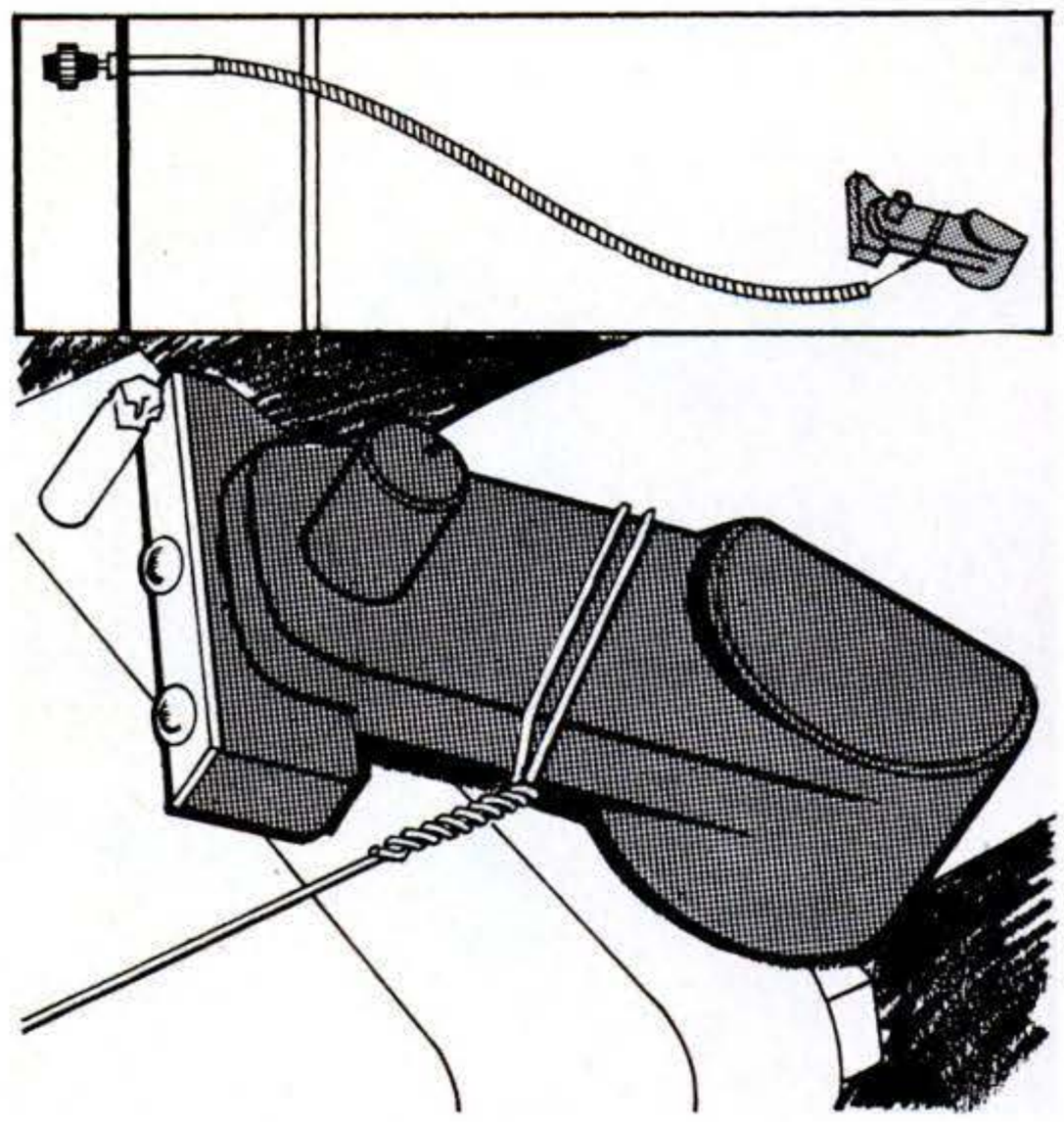
Hints from the Model Garage

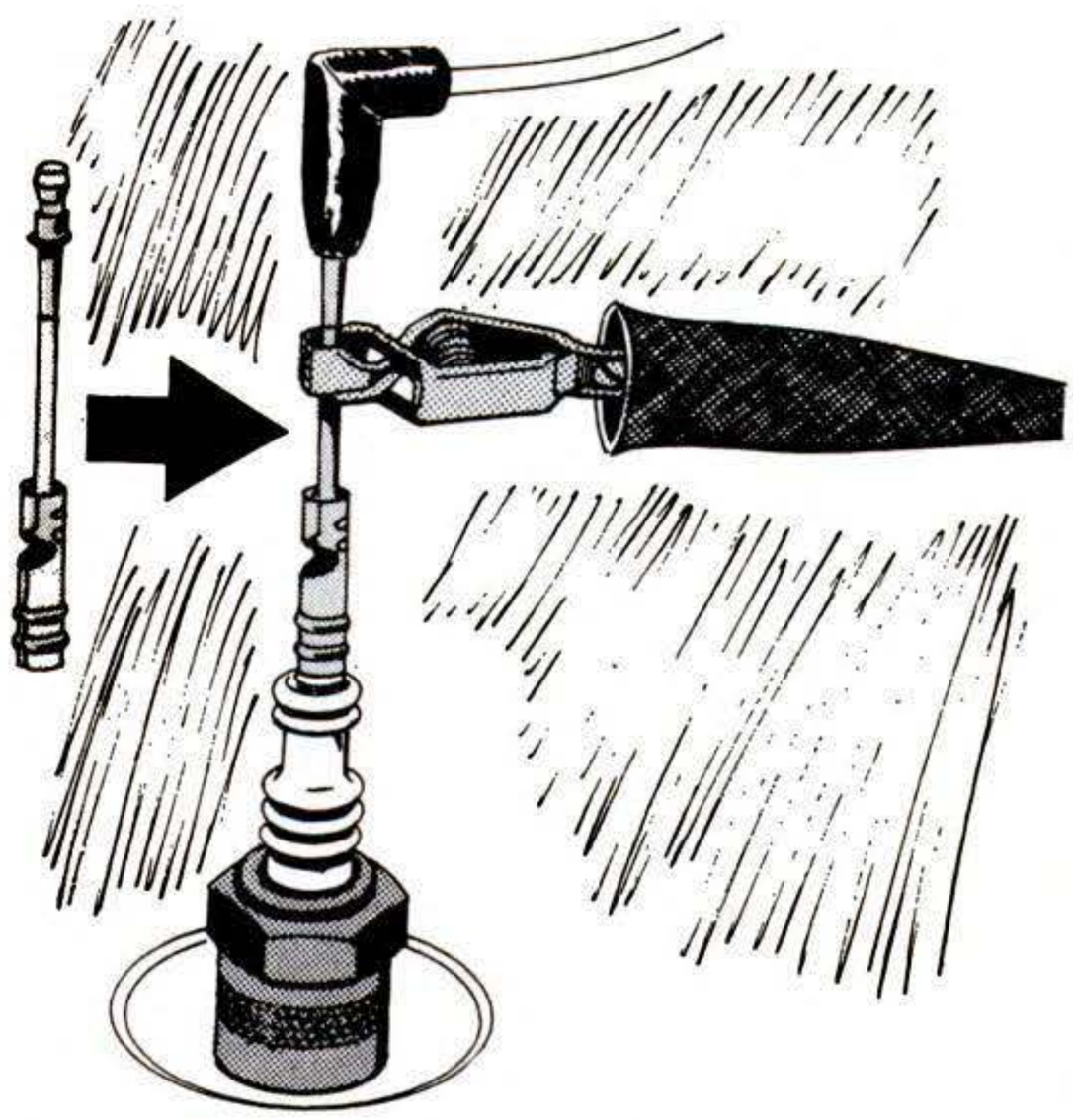
DRAWINGS BY RAY QUIGLEY



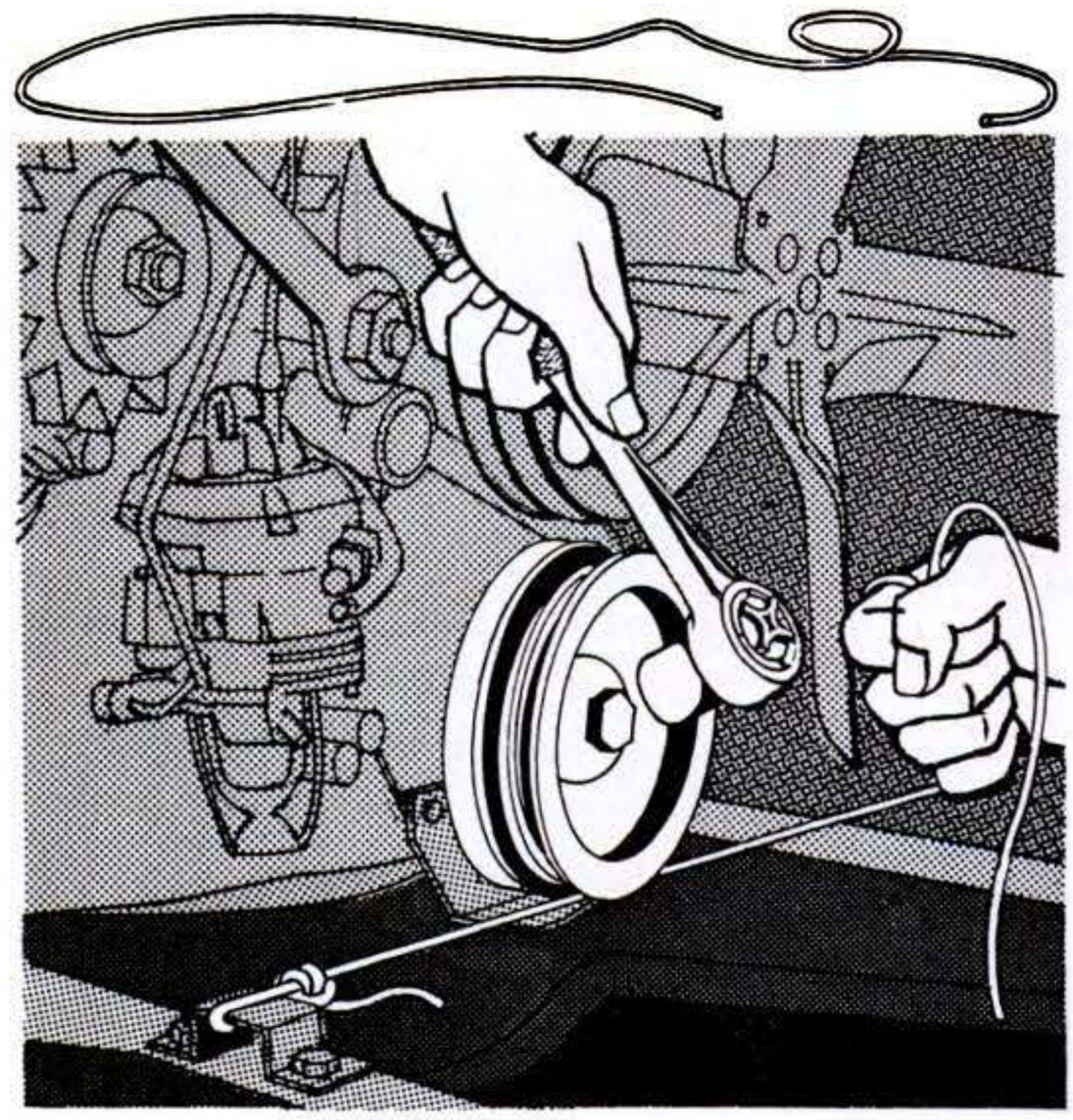
Use a threaded tubular nut from an old spark-plug terminal as an easy way to make a stop or retainer for choke or heater cables. Drill a hole for the cable in the lower part of the terminal and insert a lock screw in the threaded hole at the top.



If the heat-riser valve on your '59 Ford V-8 gives trouble, fit a manual control to it. Attach a 30-cent choke cable to the counterweight and mount the control button on the dash. When drilling a hole for the wire, take care to avoid other cables.



To attach your timing light, try this simple method: Solder a spark-plug-wire terminal to the center electrode of the spark plug, insert the unit shown above between the plug and the wire, and clamp the timing-light clip on the bare electrode.



You can remove the crankshaft pulley on cars with automatic transmission by winding a length of flexible ¼-inch line around it. Secure one end to any convenient bolt or bracket, pull the line tight—and unscrew the center nut in jig time, with ease.

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Rules of the Road Reminder

[*Continued from page 172*]

other skipper of trying to guess what you will do next.

If you are "burdened," you do not have the right of way. More bluntly, you have the obligation to stay *out* of the way of the privileged boat. How you do it is up to you; you may slow down, stop, change course, or reverse.

Once you determine whether you are privileged or burdened, the rest is easy and safe. Here is the way:

Using the "Reminder." In the large multicolored diagram, your boat is at the center. The red sector is your danger zone. Any boat approaching within it is privileged with respect to you. You must keep out of his way. He must maintain his course and speed to help you do it. If you both obey this rule, the two boats cannot reach the same place at the same time and collide.

You are privileged over boats approaching from all other points of the compass—the green and blue sectors. They must keep out of *your* way.

The red sector extends from dead ahead to two points abaft the starboard beam, an old salt would say—or 112½ degrees clockwise. The green one goes equally far the other way. The blue one astern covers 12 points or 135 degrees. (There are 32 points to a circle, eight to a right angle; one point is 11¼ degrees.)

Who is privileged and who is burdened should now be clear. The next thing is what to do about it when you are actually at the wheel. A boat's horn or whistle now comes into the act.

Using the horn is restricted by law to certain definite signals, for equally definite situations. It is never used to toot "hello," or—as an auto horn may be—to tell the fellow ahead to step on it.

Horn signaling. When a boat approaches in either the red or green sector, the signal is one blast. The other boat replies with one blast. Then both maneuver as already described.

Suppose a boat approaches almost head-on, in the yellow segment that overlaps red and green by about a point. (At night, you would see both her running lights, red and green.) Normally the signal is one blast. Each boat swings to its right, and they pass left side to left side (port to port). But if the oncoming boat already is so far to your right that it would be safer to pass right side to right side (starboard to starboard), the signal is two blasts. Each boat swings to its left to clear safely.

In every case, exchanging signals assures each skipper that the other knows and will follow the Rules. Either boat may blow first; there is no advantage in beating the other fellow to the horn.

No "cross" signals. Note an important point in "hornology": You never argue with the other fellow by answering one blast with two, or two with one. These "cross" signals are taboo. Instead, if either boat believes a proposed maneuver unsafe or is in doubt about signals, it blows the danger signal. This is a series of short blasts (five or more on the high seas and the Great Lakes; at least four in other waters). Both boats immediately stop. They proceed only when proper signals have been repeated, understood, and agreed upon.

When a boat overtaking you (in the blue sector astern) must pass close by to get ahead, it requests your permission with its whistle. One blast means it wants to pass on your right side; two blasts, on your left side. If *you* consider the maneuver safe, you repeat the signal, and the other fellow shovels on the coal. If you don't think it safe, you blow the danger signal—and the fellow astern must stay there until you tell him he can safely pass.

Naturally if you must ever depart from these Rules to avert a collision—which, after all, is their primary purpose—they are not inflexible. So in effect says the Coast Guard's common-sense Rule No. 27, its "General Prudential Rule."

Believe it or not, you have now absorbed the gist of three Coast Guard booklets. But you have only their gist; it will be well worth your while to get and read the one that applies to your boating area. They are "Rules of the Road: International-Inland (CG-169); Great Lakes (CG-172); Western Rivers (CG-184)." All are free from any Coast Guard District Office or from the Commandant (CHS), Coast Guard Headquarters, Washington, D.C. 20591. PS

Top 10 Color TVs

[Continued from page 78]

We could find no relation between type of circuitry and performance. The same holds true for workmanship.

By and large, every color TV we tested was well built of good quality components. In some, however, the high scorers in this category, the manufacturer has taken extra care with small details.

What about X-ray danger? Theoretically, X rays can be emitted whenever a beam of electrons, set in motion by a voltage somewhat over 20,000 volts DC, strikes a suitable metal surface. This situation exists inside the voltage-regulator tube that is part of the high-voltage power-supply circuitry of many of the sets we tested.

In most sets using this tube, metal chassis components that surround the tube, backed up by the set's cabinet, provide adequate shielding and prevent most X radiation from leaving the set. However, as has been widely publicized in recent months, a few brands have "leaky" shielding, and do in fact emit X rays (usually to the sides, bottom, or rear of the set) at levels exceeding the suggested maximum established by the National Council for Radiation Protection and Measurement.

We did not include an X-ray-emission-level category in our test report, since, as this is written, various government-sponsored studies are under way to clarify the situation and more precisely define the hazards involved.

The information we have is best summed up in this quote from a report by the Public Health Service (U.S. Department of Health, Education, and Welfare):

". . . Surgeon General William H. Stewart emphasized that the potential biological damage is quite low and advised that even this potential could be minimized by operating the set within power limits which would not increase X-ray emissions; having the set serviced only by authorized repair personnel with adequate equipment to check power level; maintaining viewing distance of about 6-10 feet in front of a color television set; and avoiding any prolonged exposure in the rear and side areas of a color set." PS

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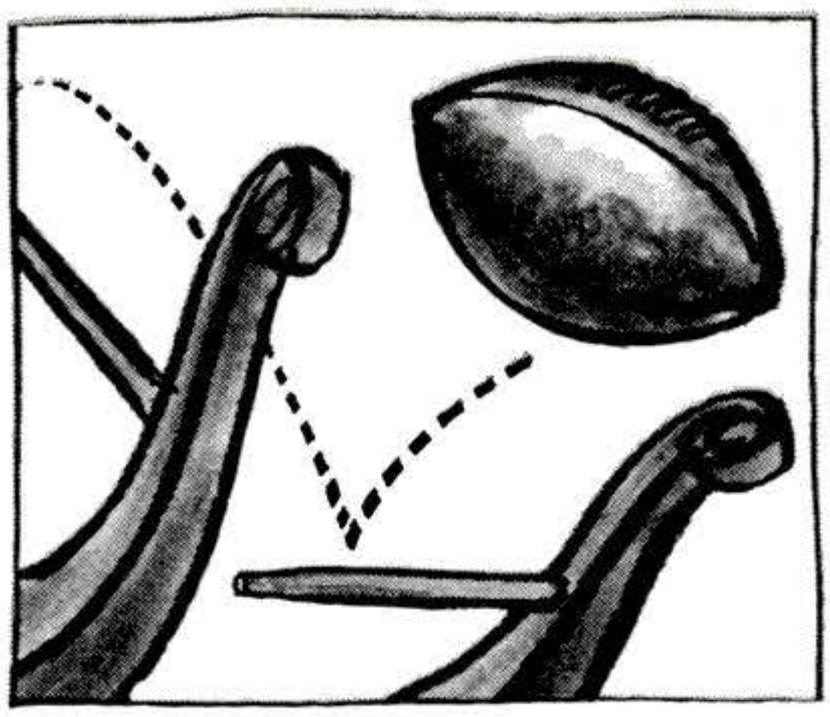
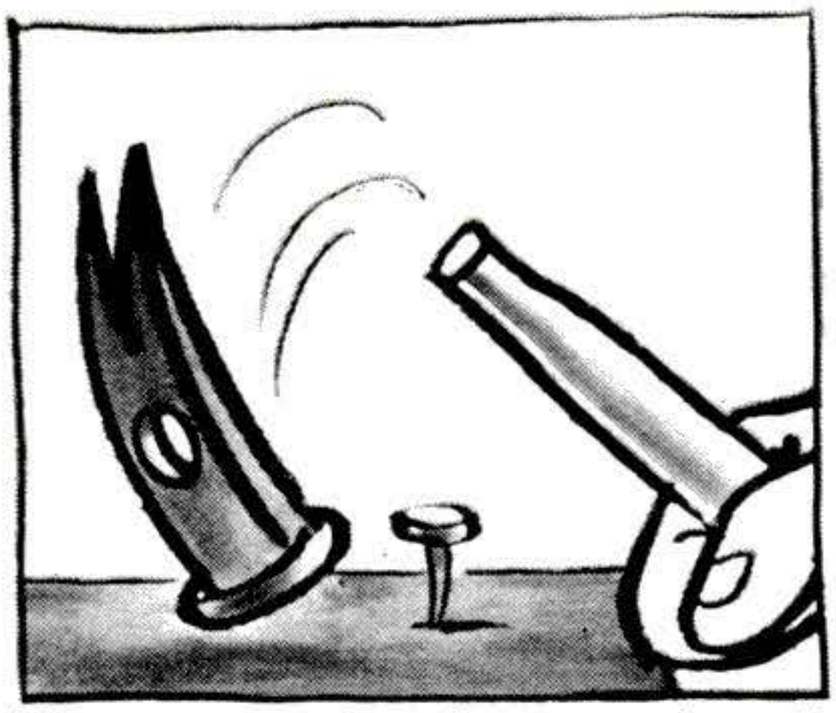
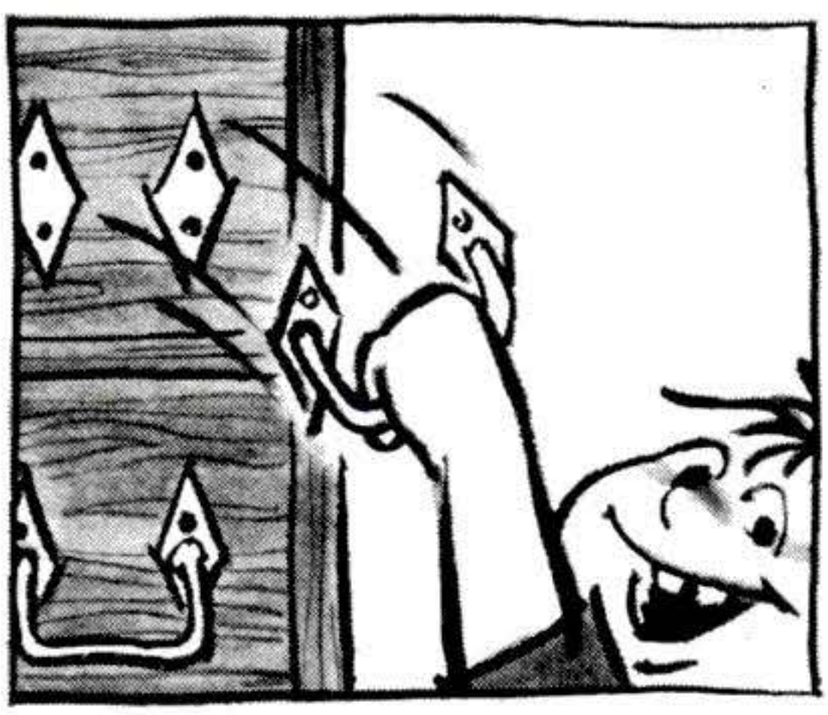


Kids use the chair as a goal post?



There goes that hammer head!



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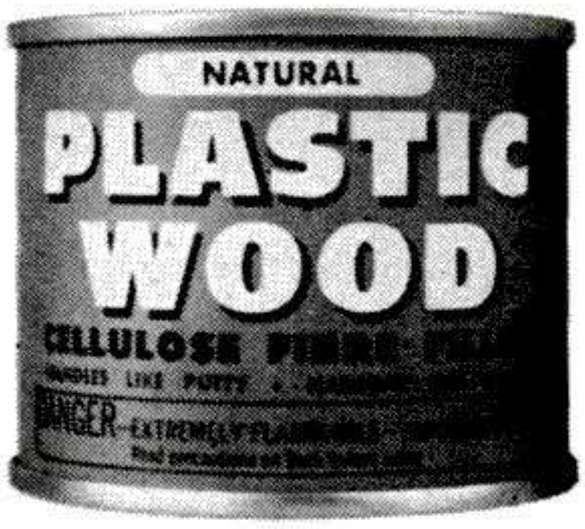

Handles like putty—comes in 5 colors.

[*Continued from page 87*]

senger compartment combine to produce a spartan look. Next, exterior styling. It's great, if you think of it as being built on the Valiant underbody. But it looks tall and funny next to a Camaro, and its overall appearance can hardly be called contemporary. Nobody gave it a second glance, while the Javelin attracted all kinds of attention. More problems:

- Forward mounting of rear seat steals leg room (but even head room is scarce).
- Turn signal lacks a lane-change device.
- Steering wheel has waxy feel, like other '68 Plymouths.
- Seat-back lock inconveniently placed at bottom of front seat.

Javelin's worst feature was the remarkably high noise level at cruising speeds—traced to a nonstandard final-drive ratio. Javelin also has the same parking-brake problem that annoyed us in the Camaro (Mustang and Barracuda have umbrella-handle parking brakes). Another glaring fault is the lack of an integrated interior style. Seats, door panels, instruments, console, carpet, glove box—all are very well designed and made, but each has its own style and finish; they look as if they belong in different cars. Further complaints:

- Door locks are difficult to operate. Design seems okay but locks sometimes stick.
- Window-crank knobs are too small to grip firmly.
- Trunk is just too small to be of much use; it holds one suitcase only after much cramming.
- Seat belts make backrest adjustment difficult.

CONCLUSIONS

Dunne: I think the Mustang has the best combination of performance, style, ride, and handling. I'm impressed with the quality of the test car, and if they're all like that, Mustangs should have another successful year.

Norbye: The Camaro suits me better. For all-around use, its handling is adequate. The ride is excellent, and the car is quiet and comfortable. As for performance, it does whatever you want without apparent effort. PS

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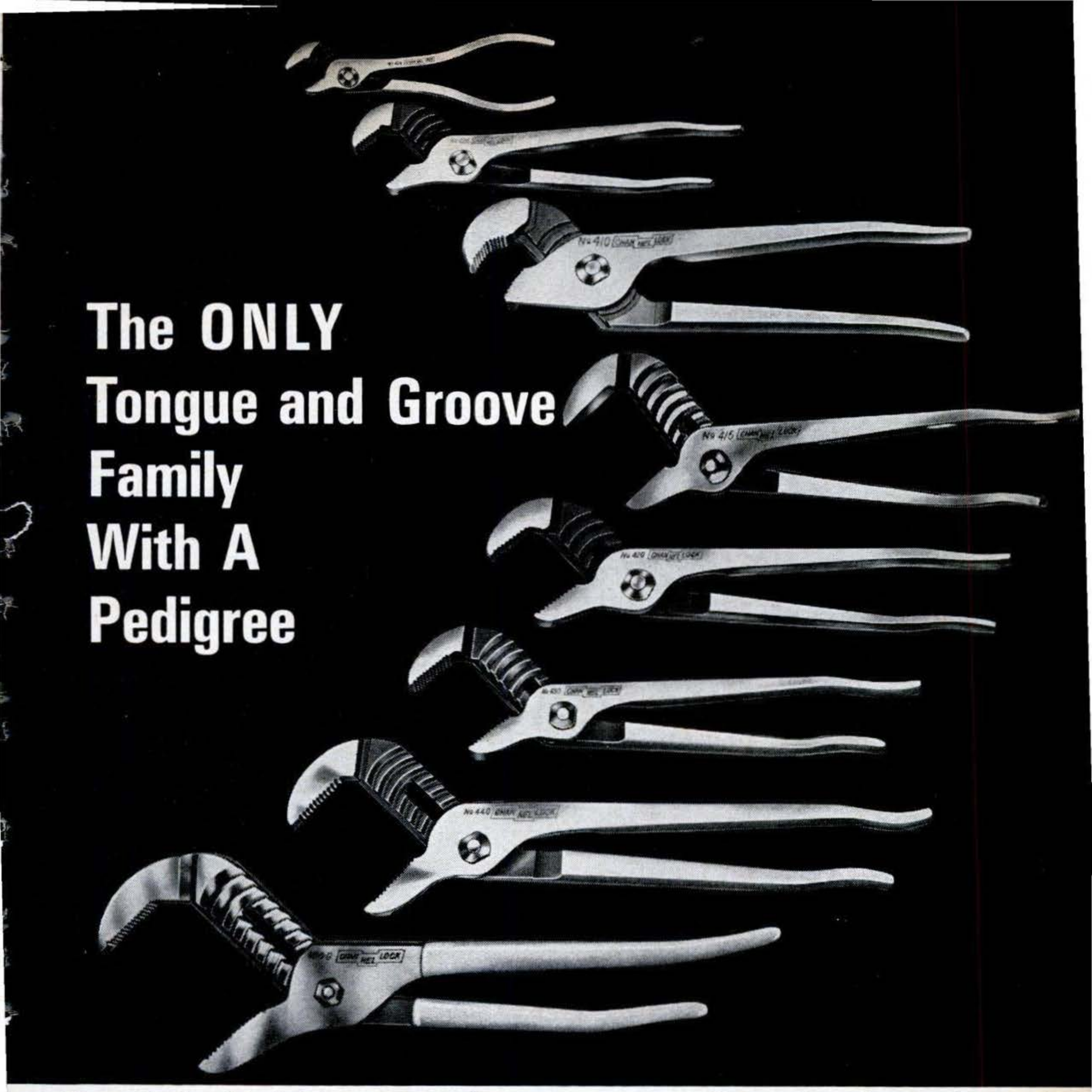

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Engineering Masterpieces . . . Your Feet

[Continued from page 81]

Painful heel problems. These are common among policemen and others whose jobs require much standing or walking. Dr. Paul W. Lapidus of New York, an orthopedist, reports that patients respond readily to medical treatment.

Bunions. This is bursitis of the big toe, caused by tight shoes that press on the toe joint and the bursa, a little fluid-filled sac in the joint. The joint becomes inflamed—and the metatarsal bone becomes misshapen. "Bunion-last" shoes, made wide through the forefront section, may help. Surgery is sometimes required.

Hammer toe. Also called claw toe, this is another deformity that can be caused by poorly fitted shoes. It leads to undue pressure and corn formation. While severe cases may require surgical correction, conservative treatment—which includes use of corn plasters, new and well-fitted shoes, and toe-stretching—often offers relief.

Plantar warts. These common warts that develop on the soles of the feet and then are flattened by pressure can be exquisitely tender. Sometimes they yield to medication. Recently, Dr. Bernard E. Tropp, a Newark, N.J., Health Department podiatrist, has reported promising results with ultrasonic waves in eliminating plantar warts.

Athlete's foot. Much that passes for athlete's foot really isn't. Real athlete's foot is a fungus infection called *tinea pedis* and ringworm. It often can be licked with a special antifungal antibiotic.

In many cases of athlete's foot, moisture from excessive sweating and the maceration of the skin it produces may be more important sources of inflammation than funguses. To combat the moisture and maceration problem, doctors prescribe thorough drying between the toes after bathing, rubbing away of the macerated skin, and routine use of a drying powder (either zinc stearate or a combination of zinc stearate and zinc oxide with talc).

Allergic reactions to shoe materials can cause what seems to be athlete's foot. Nonallergic shoes may clear this up.

Chronic corns. Friction and pressure cause a corn to develop. Corn plasters may provide some relief—and, if the fric-

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Engineering Masterpieces . . . Your Feet

tion and pressure came from badly fitted shoes, a change of shoes may solve the problem.

But in many cases of recurring corns, the cause is a bone deformity—a bony growth that produces trouble by rubbing against the underside of the skin during walking.

Dr. Milton Roven, a podiatrist at Linden General Hospital, Brooklyn, N.Y., reports a simple surgical procedure to correct the bone deformity. It involves making a small incision near the bony growth, inserting a tiny rasp, and literally filing away the offending bone. The procedure can be carried out in a podiatrist's office and the patient can resume walking immediately with little or no pain.

Avoiding trouble. Most common foot troubles can be prevented from happening in the first place—or from recurring.

Good shoes properly fitted are essential to foot health. Buy them late in the afternoon; your feet will be bigger then. Don't tell the salesman your size; let him measure. Make certain the shoes are wide enough to accommodate the widest part of your foot and that there is room to extend your toes fully.

What should you look for in a good shoe? Soft upper, moderately broad heel, narrow waist, straight border along the inner sole. Socks should be a quarter-inch longer than the longest toe. If you perspire a lot, wool or cotton is preferable to synthetic material.

Tips on foot care. Clip toenails straight across—no rounding of the corners—to minimize any chance of ingrown nails. Bathe your feet daily and dry completely with a terry-cloth towel.

Don't monkey with your feet. If any kind of trouble pops up and persists for more than a few days, do what you'd sensibly do if the trouble were in an arm or the throat or the chest: Get professional help to diagnose it and treat it before it can get worse.

It was Abraham Lincoln who once complained: "When my feet hurt, I can't think." Enough is known today so that with a little forethought your feet aren't likely to hurt—and, if the foot doctors are right, you'll be less likely to hurt elsewhere. PS

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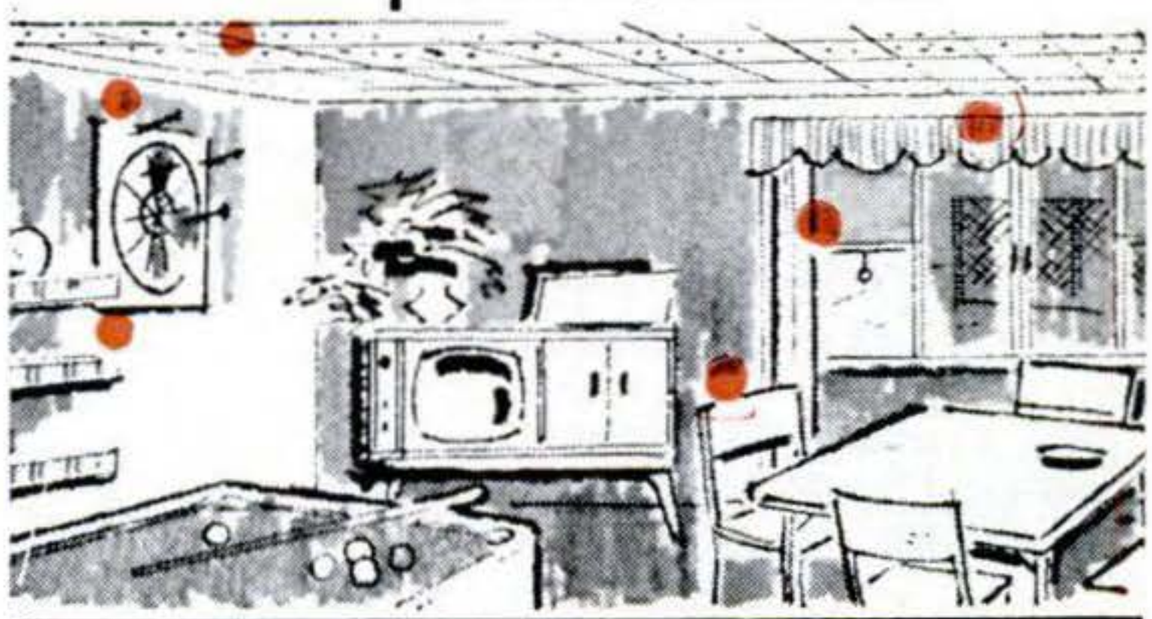

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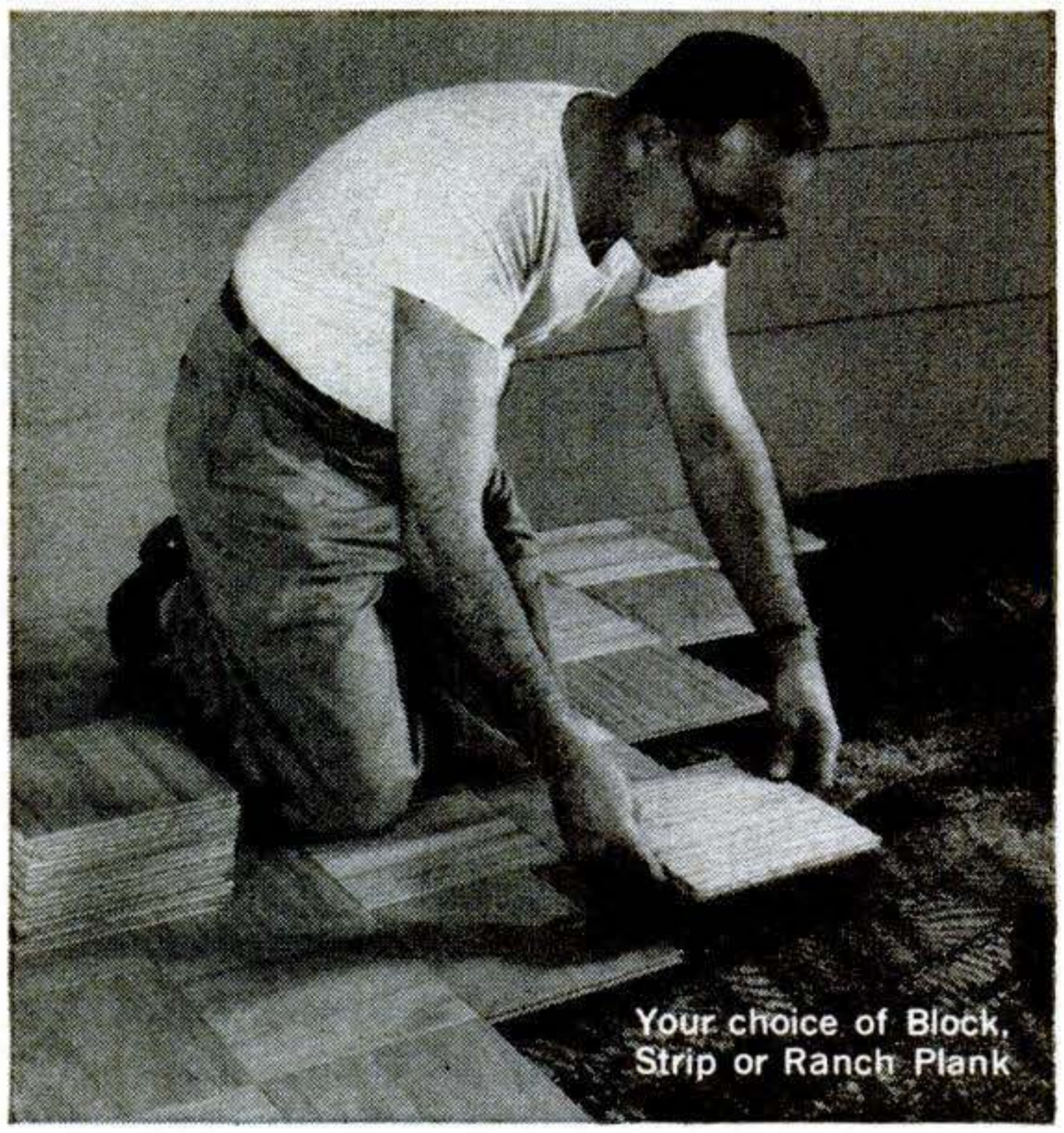

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Let's Look at the Power Mowers for '68

[*Continued from page 131*]

more than his share of base markers and Indian mounds in the yard.

Also interesting is the deck system on Atlas Tool's seven-hp., 30″ reacher. The deck support resembles a scissors jack with crossed arms on each side for accurate geometry, and a fine, ball-handled lever right where the user wants it. Other good points: 16″ rear and 11″ front pneumatic tires, parking brake, two-pedal control, transaxle drive.

Hahn-Eclipse has done something special with their 32″ Pow-R-Boy rider with a planetary-drive system. There's a five-speed drive, parking brake, foot-controlled blade engagement, no-roll-on-hills safety brake, and twin-blade cutter.

Medium-price riders. Here's where the competition is heaviest, so it's here that features abound to catch your eye. For example, Toro's "Big Red" six-hp. swings twin 5″ blades in a 34″ swath, has an automatic blade brake, safety interlocked electrical system, a man-sized bagger outrig, and an adjustable safety seat.

Gilson has two new front-reach riders, a five- and seven-hp. with 25″ and 34″ cut. Gilson cleanness of design and good deck controls are evident.

Compromising a pan-type chassis with reach-type positioning and features, MTD Lawn Flite has also brought out five- and seven-hp. models with 30″ cut. Families with youngsters driving the mower will appreciate the pan design that keeps feet safely away from machinery.

Further evolution in reach design is found in Bolens' Suburban 24″. It has an almost flat deck, centrally mounted engine, and unusually good transmission features with full gears and a differential of automotive-gear type.

Montgomery Ward is proud papa of a new six-hp. Garden Mark 88. This 30-incher sports a three-blade cutter, reach design, two speeds forward, clutch/brake pedal, and big fat tires. Money-wise it may come in as "best buy."

Styling doesn't cut grass. Some buyers equate cutting capability with mower styling. They may conclude that a rig that looks like a tractor can do more than a reach type or other style. This is not so. Cut is simply a matter of blade

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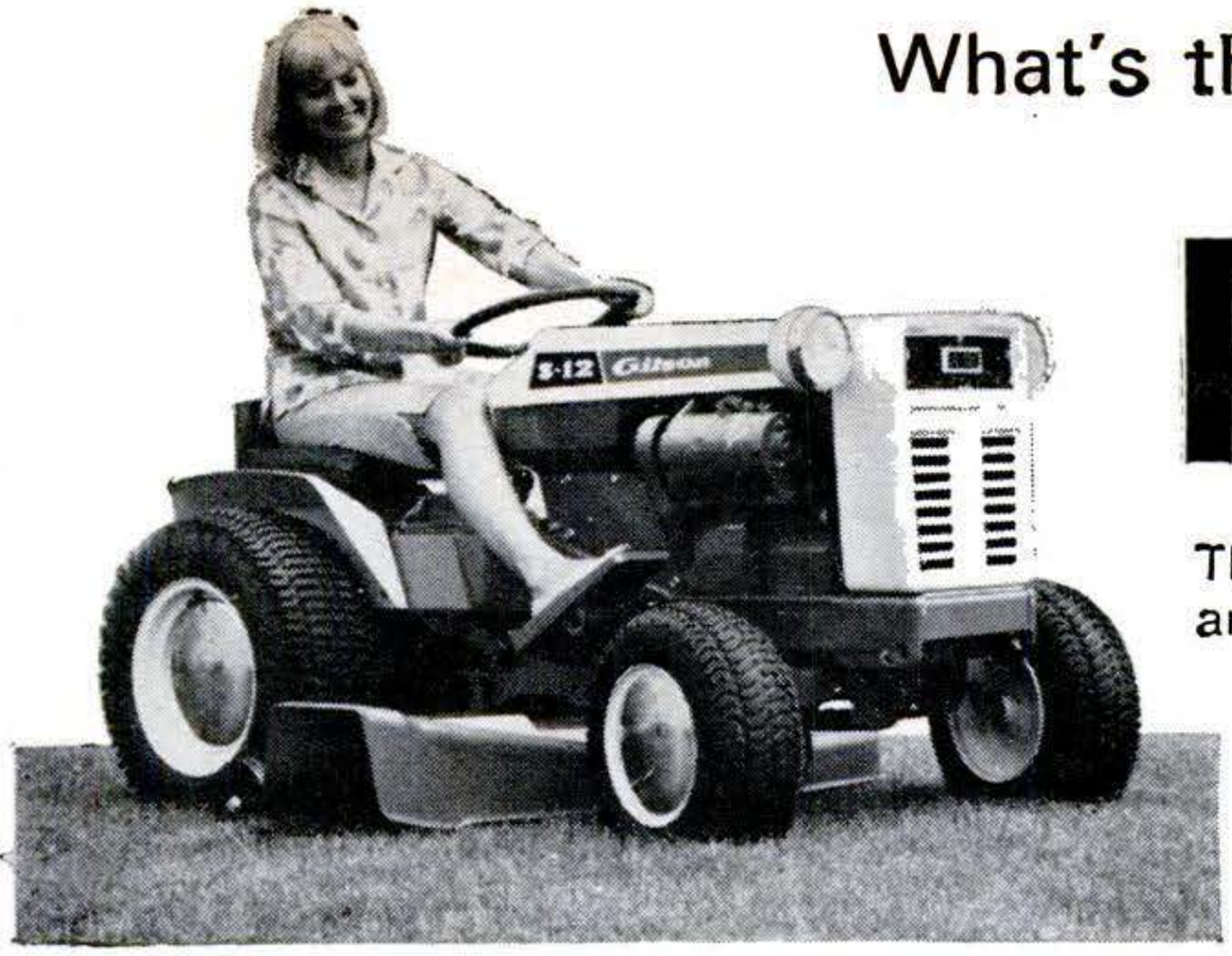

What's the Gilson S-12 got that other tractors haven't?

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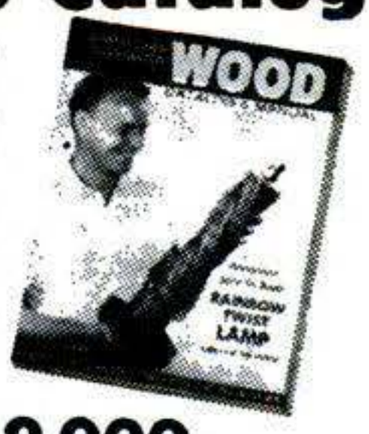

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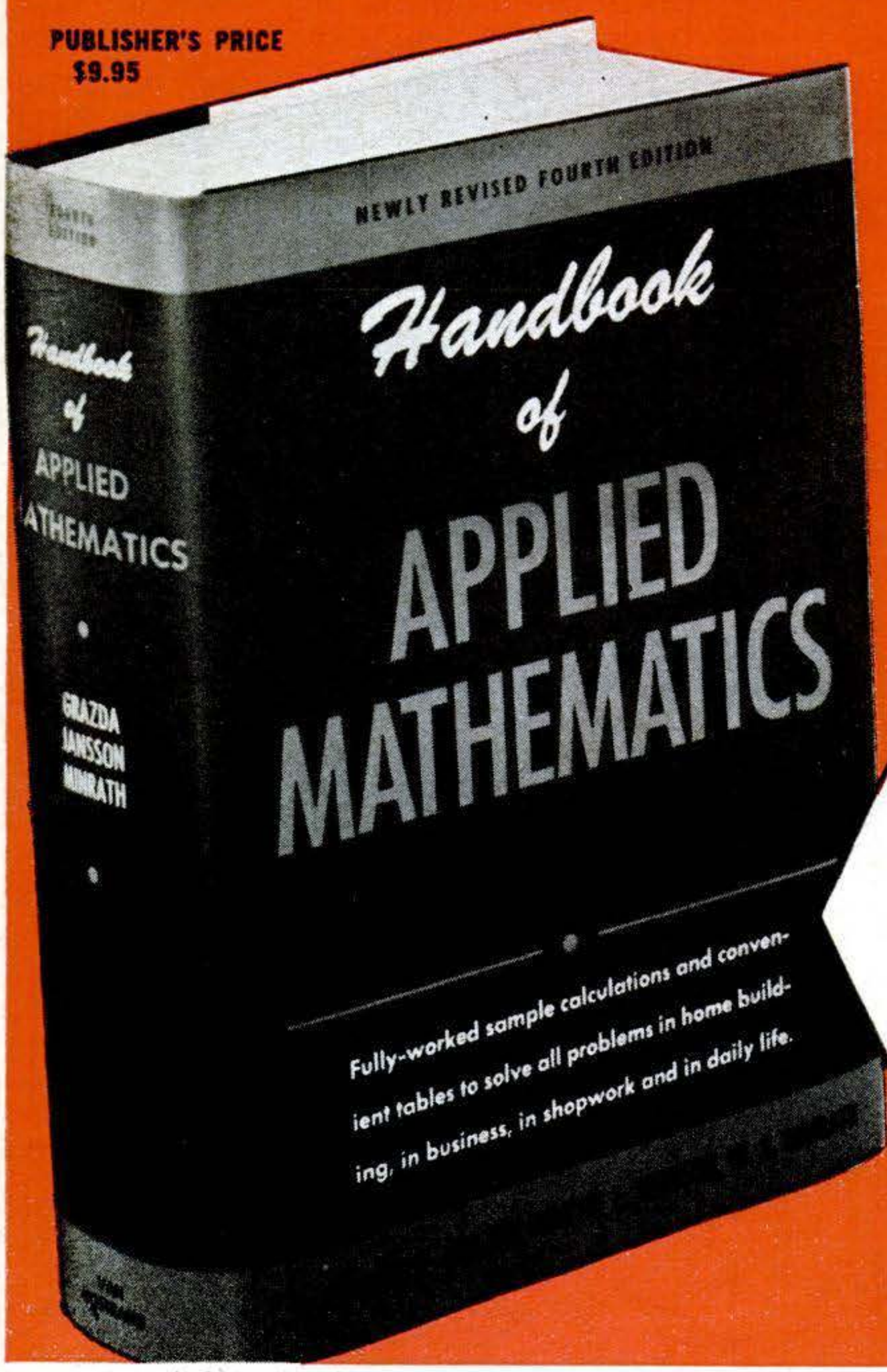

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Let's Look at the Power Mowers for '68

and power. The blade doesn't know what shape is carrying it.

Many fine mowers, of course, are made in the front-hood tractor pattern. Since many are also capable of driving or pulling various other attachments, they'll be covered with tractors in PS next month.

The hand-push rotaries. A look at this part of the market shows interesting developments. Allis-Chalmers, well known for industrial equipment and farm machinery, offers a 19" and a 22" walk-behind rotary pair. The 22-incher features an indirect belt drive to a separate blade shaft to protect the engine if obstructions are hit. Both models have heavy-duty, cast-aluminum housings, steel wheels with ball bearings, carefully designed and located discharge chutes, and handle-mounted throttle controls.

A Sears 20" rotary (model 91417C) has a passel of new features, including "cam-release" starting to ease starter-rope action. This is combined with hydraulic primer and a "pull-up" recoil starter.

Other good items are a visual gas gauge, improved oil fill and drain, a magnesium housing, and a wiper blade above the cutting blade to help keep the housing clean. Special attention to the grass catcher has given it a wide discharge chute and adjustable deflector. The catcher comes with the mower.

Definite safety and convenience features for a hand-push rotary combine nicely in Yardman's 20" Model 2180 with twin-thickness cutting deck and a safety clutch/brake that enables you to start and run the engine and then engage the blade with a toe touch from a safe position behind the mower. The adjustable handle lets you fit the mower to your height and, when finished, fold it up for mower storage or transport.

Self-propelled rotaries. A new 21" Lawn Boy with electric start is typical of one widely used drive system that presses a knurled or cogged drive pinion against the tread surfaces of the front or rear tires. The simplicity of such a drive is highly practical—it's easy to see what's worn or out of adjustment if the drive weakens.

AMF/HOMKO in a new 22" Diplomat uses a similar drive, but the pinion mates

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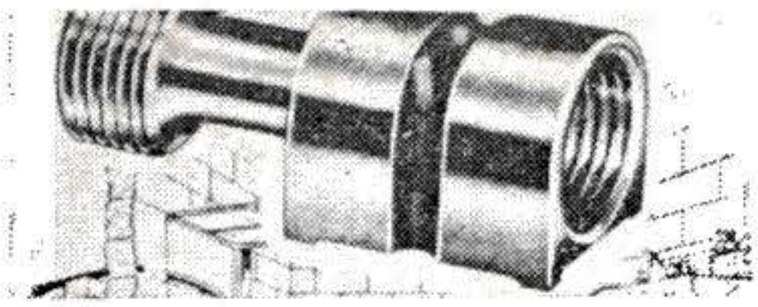

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Let's Look at the Power Mowers for '68

with a ring gear on the inside of the wheel faces.

Jacobsen, old pros at the mower game, offer four-blade rotaries. Short blades, 90 degrees apart on the rim of a disk or "flywheel," turn away on impact with a solid object and can be reversed for new cutting edge. Clutch engagement is via a Twist-Grip handle. Fold-down handle is standard.

Sears' top-of-the-line self-propelled models have four hp. and chain-and-gear drive. The "Sears' best" mower has a two-speed gearbox, an outstanding feature for use in tall grass that takes full engine speed but also slow forward speed. Also of interest: nickel-plated ignition points for long life. A gas gauge is standard on the top mower.

Ward's mowers are attractive enough to make you *want* to mow the lawn. The self-propelled Dial-A-Speed allows you to select ground travel rates to match mood, ambition, and cutting condition. Safety handles stop them when released.

Huffy, carrying its single-lever height adjustment through to the self-propelled line, has two new ones this year—the Deluxe Broadlawn with chain drive to the front wheels and the Fairlane with friction drive to the rear wheels.

Front- or rear-wheel drive? Arguments can easily be started over this, but it boils down to what your yard problems are. Front-wheel-drive advocates point out that it's easy to apply down-handle pressure to raise the front wheels for backing and swinging without bothering to disengage the clutch. Others, with such engineering power as Allis-Chalmers mowers, promote rear-wheel drive to get engine weight and traction effort on the rear and good front clearance for sneaking under bushes. The Allis-Chalmers 22" self-propelled is rear drive and built to last. Big 10" rear tires float over chuck holes, and there are ball bearings all around.

It may be that the answer to the front-vs.-rear-drive controversy lies in the difference between the small yard with need for many quick, short cutting movements and the big yard with the need for hill climbing and getting over rough lawn. PS

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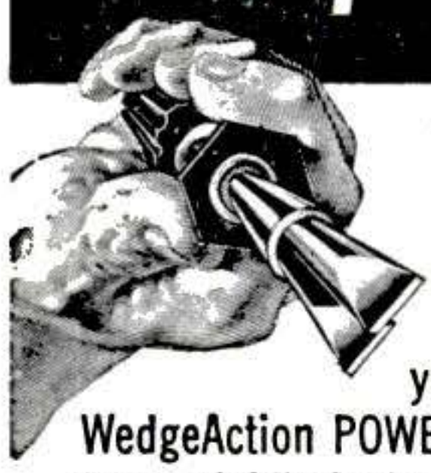

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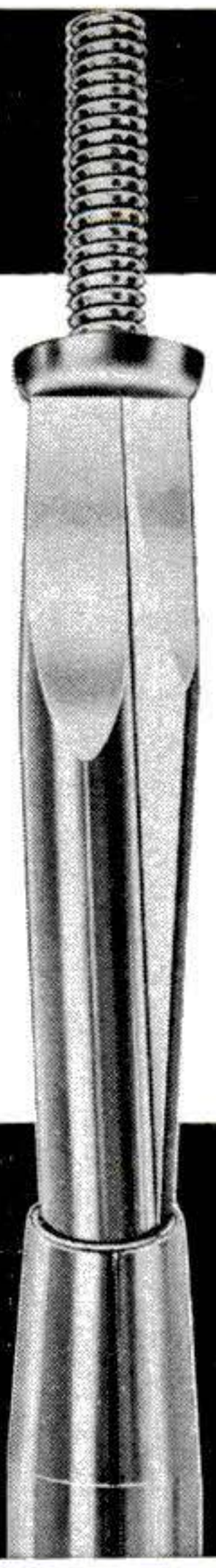

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New Batteries Pack More Power

[*Continued from page 93*]

that lithium reacts with water and decomposes it, making the use of ordinary water-based electrolytes impossible.

Gulton Industries neatly solved this problem by using a nonaqueous compound with oxygen in it to oxidize the lithium and another chemical which ionizes the electrolyte to make it highly conductive.

The new battery will stay sealed to keep moisture out, and will be completely maintenance-free. Although it will cost 50 percent more than lead-acid cells (lithium costs a bit more than lead), it has a number of big advantages.

Dr. Harvey N. Seiger, director of research for Gulton, told me the new cells would weigh one-tenth as much as equivalent lead-acid cells. This is the same as saying that their practical energy density is 100 watt-hours per pound versus about 10 for lead-acid.

Unlike the lead-acid battery in your car, the lithium-nickel battery can be 80 percent discharged and then fully recharged a thousand times. Its open circuit voltage is 3.2; when you start off in the Amitron this will drop to 2.5, but decrease very slowly from there on. Perfect energy source for an electric car? Gulton thinks so.

Since the lithium battery has a relatively low discharge rate and a lot of power is needed to accelerate a car from standstill, Gulton is also making a nickel-cadmium "acceleration" battery that puts out the needed surge of power.

With this combination, the Amitron will take off like a scared rabbit, doing 0 to 50 m.p.h. in 20 seconds and then traveling up to 150 miles at the same speed. Every time you slow down the motor becomes a generator and recharges the batteries, adding 25 percent to the car's range. A complete recharge from an AC outlet will take four hours.

The Amitron will carry two stacks of lithium cells weighing 75 pounds apiece, and two 25-pound ni-cad acceleration batteries for a total weight of 200 pounds. The equivalent in lead-acid cells would weigh nearly a ton.

Look what's coming. Among the exotic batteries of the future are the metal-air types mentioned earlier. They are actually midway between batteries and fuel

New Batteries Pack More Power

cells. The difference between these last two is simply that in ordinary batteries one electrode is oxidized by oxygen furnished by the electrolyte. In fuel cells the electrodes are not consumed and serve only to promote slow oxidation between a stream of air and a supply of a fuel such as propane.

Metal-air batteries are in between. One electrode is "coupled to the air" (the cathode) and is designed only to catalyze the reaction between the air and a metal electrode (the anode).

Leesona's zinc-air cells start out with a porous zinc anode which is given a bath of electrolyte aqueous potassium hydroxide, the same base electrolyte used in ordinary alkaline cells). The next step is to wrap the zinc anode in a porous separator and then sandwich it between two air cathodes that are waterproof but let air in from the outside. Connections to the cathodes are made with grids of silver paint.

There are secret ingredients. There's still much of the black art involved. In both fuel cells and metal-air batteries cathodes are coated with chemicals to promote the necessary reaction between air and fuel or air and metal. Often this is a rather expensive platinum or other compound, the exact nature of which is guarded by the manufacturer. New types of electrolytes and depolarizers also involve secret ingredients.

But metal-air batteries are on the way. "We'll probably test-market our primary A batteries around the end of 1968," says Leesona president Anthony Moos. "The price of the battery? It'll be competitive."

Moos and spokesmen for General Atomics Divison of Gulf Oil, GE, Yardney, and Ford also want to produce rechargeable zinc-air cells for electric cars.

GM and Union Carbide are working intensively with fuel cells. "We believe fuel cells will be the ultimate answer for electric cars," says one Carbide executive. "At least for the electric equivalent of today's gasoline-engine automobiles."

One thing is sure. With all the pressure to find new portable power sources, we're going to see even more power put into amazingly small packages. And if you'd like to try your hand at battery design, the field's wide open. PS

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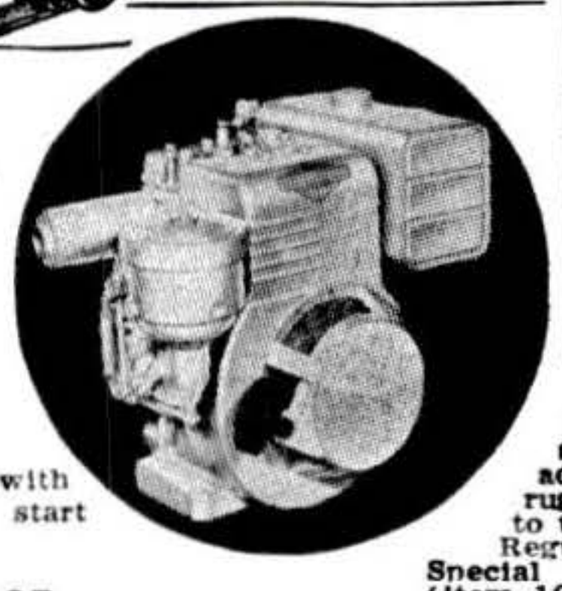

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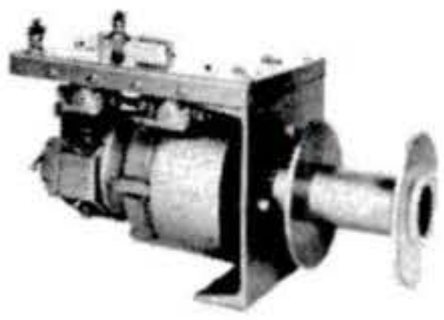

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"Inner Space" Rehearsals

[Continued from page 108]

tank for themselves—and come up with a design better suited for zero-gravity operations in a spacesuit.

With scuba gear, it's another story. After exposing all my clumsiness in the spacesuit test, I tried performing the identical tasks in swimming trunks and scuba gear. The job in the spacesuit had made me perspire so profusely that I really longed for a refreshing swim—for physical contact with the water from which the spacesuit had separated me. And now I was in a familiar element.

I have been an active scuba diver since 1955, when the Sons of the Beaches of Los Angeles introduced me to this most fabulous of all sports. My thrilling experiences have included an encounter with two sharks, the spearing of a six-foot moray eel (which some scuba divers would respect more than a shark), and, at the invitation of Ed Link, free-diving from his research submarine Deep Diver while it lay at the sea bottom on the Continental Shelf off Grand Bahama Island.

The space rigger's tasks that were so difficult in a pressurized spacesuit turned out to be a cinch in swimming trunks and scuba gear. There was no spacesuit pressure to fight as I moved my limbs. My flippered feet gave all the maneuverability I wanted.

But, of course, kicking your feet won't get you anywhere in an air-filled environment, let alone an airless one! It is the first thing a skin diver has to unlearn when he turns to neutral-buoyancy work, for it would lead to wrong results.

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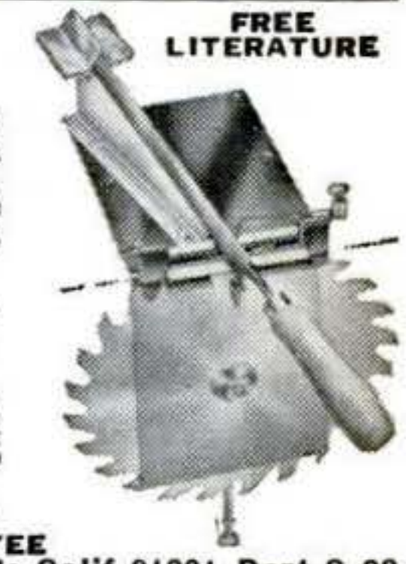

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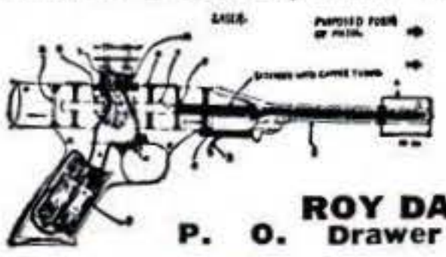

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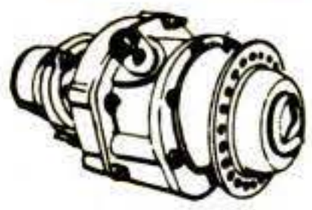

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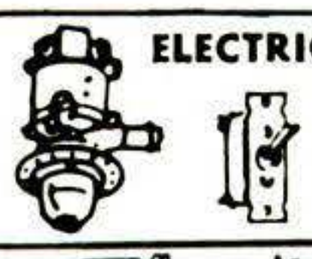

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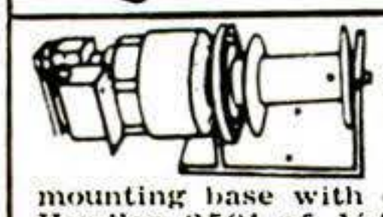

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Should You Switch to Electric Heat?

[Continued from page 137]

$370 for storm sash. Typically, such costs would be spread over a 10-year period with a home-improvement loan.

The bonus. There are additional advantages. The extra insulation means a cooler house in hot weather and a reduction of air-conditioning costs. In winter, it means improved comfort. Chilling drafts aren't caused by air infiltration alone. They are caused by the wash of air down cold walls and window glass. Improved insulation and storm sash stop this. You will be comfortable at lower thermostat settings. These improvements also give you a quieter house, by muffling outside noise. And electric heat itself is generally the quietest of all systems.

A larger electrical capacity may not only mean power for new appliances—it can mean reduced cost. Many homes with inadequate wiring have a voltage loss because insufficient electricity gets through. This loss is electricity wasted in heating up wires and electric motors, at no benefit to the consumer. It adds substantially to his bill. Electric motors operated at insufficient voltage burn out prematurely. Insulation on electric wires, heated up because of their incapacity to handle loads, turns brittle; it may become a fire hazard.

New insulation methods. Improvements have been made in the blowing in of insulation in existing walls. A new cellulose-fiber insulation can be applied in greater quantity and settles less. An inch thickness of new urethane and plastic foams is the equivalent of two inches of standard insulating materials. New glass fire screens are effective in stopping heat losses up the fireplace chimney. They can serve as a damper when a chimney has none, and give better draft control even when there is a damper.

Insulated walls need vapor barriers. There are new paints and sealants made especially for the purpose. Lower-cost vinyl wall coverings are also effective.

That sums up what's likely to be involved in converting an older house to electric heat. You weigh the cost and minor temporary inconvenience against the quality and long-term convenience. There's little doubt that it's a heating system with a bright future. PS

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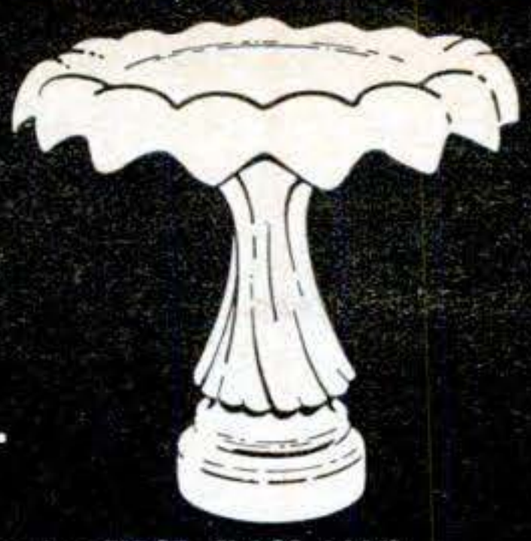

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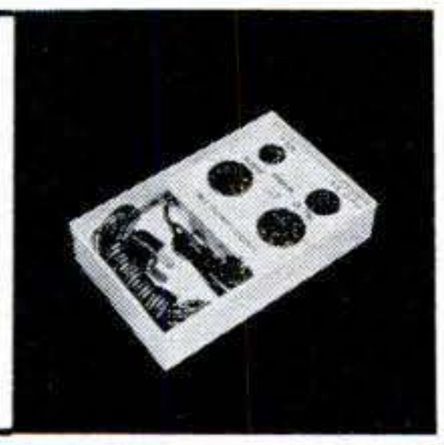

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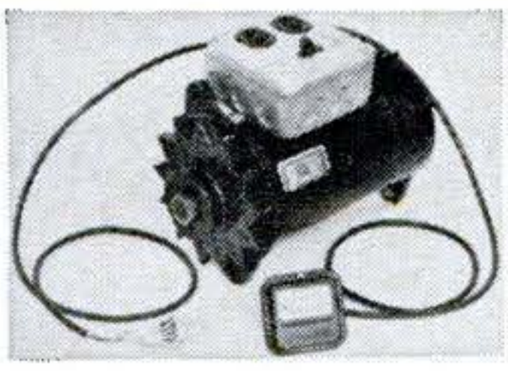

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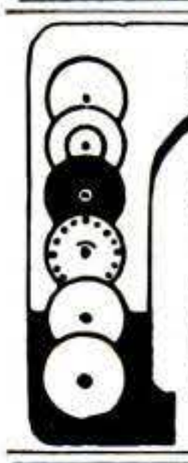

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So You Want to Read Faster

[*Continued from page 99*]

w.p.m., I'd need 20 hours to get through the book.

But I sped along at the fastest clip I could—maybe 2,000 w.p.m. In three hours I had finished. Did I understand it? Not at all. But I picked up what I needed for an article I was researching.

Weisenfeld had us take a whole minute to read one 300-word page during our sixth class. It was excruciating to go so slowly. And 300 w.p.m. is 100 words faster than my beginning speed.

Better and better. Finally, the last session. And another test. The book was the same we had used for our entrance exam, a biography of Albert Einstein. Eight weeks before, I was reading at 200 w.p.m. with 85-percent comprehension. My final score: 1,520 w.p.m., 92½-percent comprehension. My speed had multiplied more than seven times.

Can I honestly say I *read* that fast?

No, though Evelyn Wood will heartily disagree. I believe I did get two important things: the ability to *skim* effectively at anywhere from 1,000 to 2,000 w.p.m., though I get very little of the "flavor"; and possibly a tripling of my "comfortable" reading rate.

Whether or not I'll lose the technique is another question. The only wide survey of ex-students—1,800 of them from the San Francisco area—showed that after a year one-third of the people weren't using the method at all, and had slipped back to their old rates. Another third said they use it sometimes, and that probably they have maintained speed. But the rest of the students—many of whom had attended free brush-up workshops—said they felt they were reading faster a year later.

In day-to-day use, I find a few minor negatives. For example, in order to keep at my new rates I must continue to use my finger. And reading while eating presents a problem.

Also, there is a nagging doubt that at those high speeds I'm giving the author a fair shake. But then, if I didn't skim many books, I wouldn't have time to read them at all. PS

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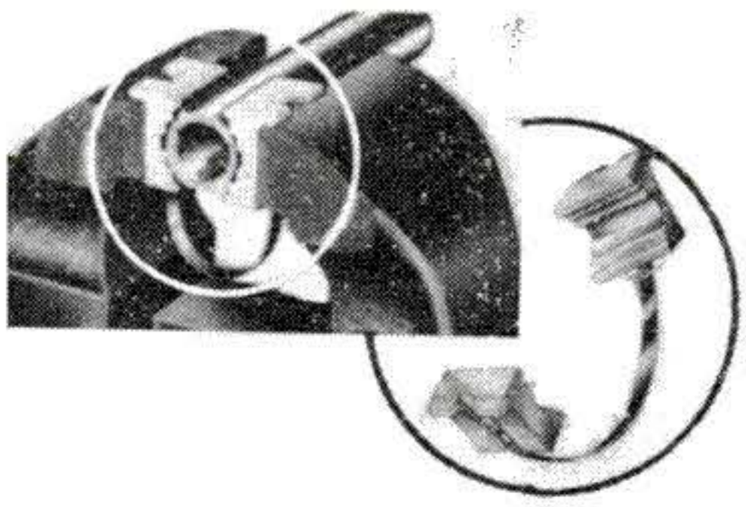

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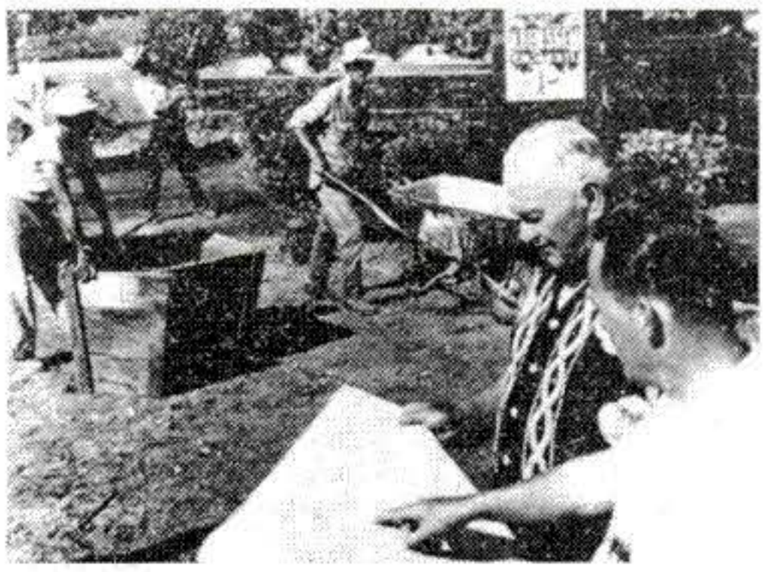

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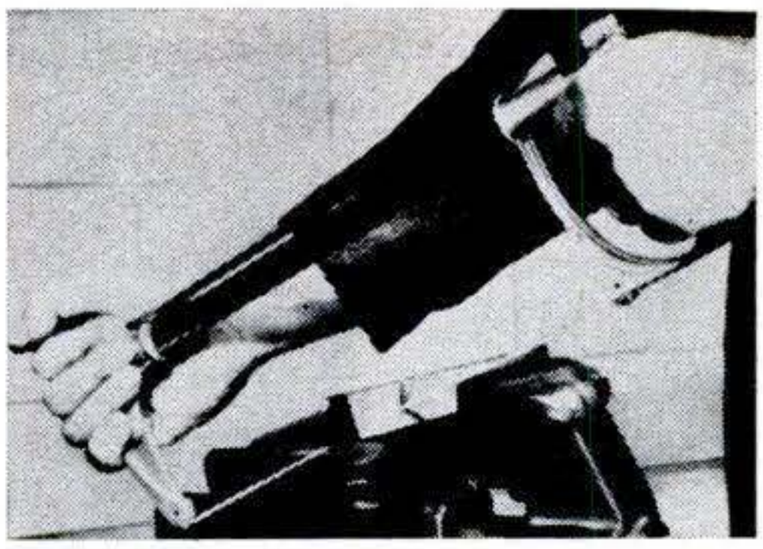

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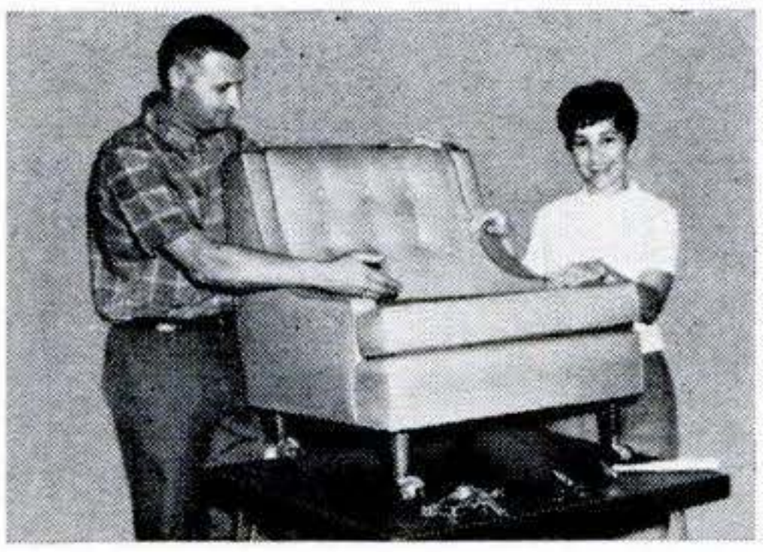

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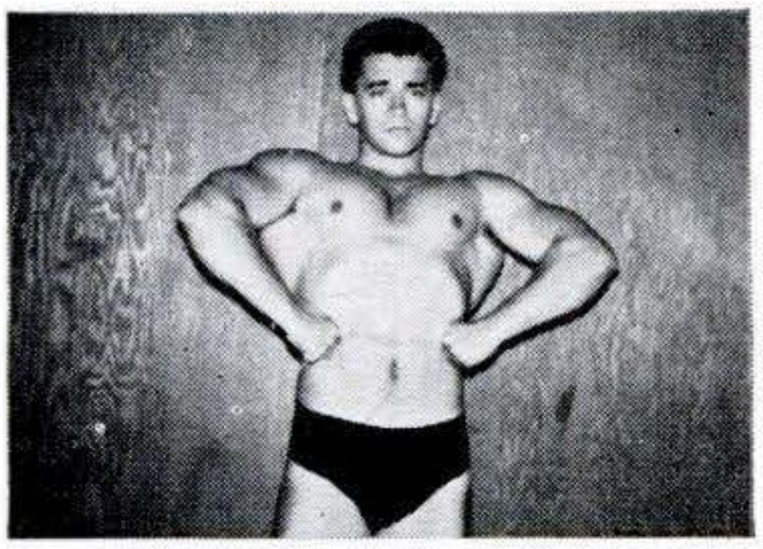

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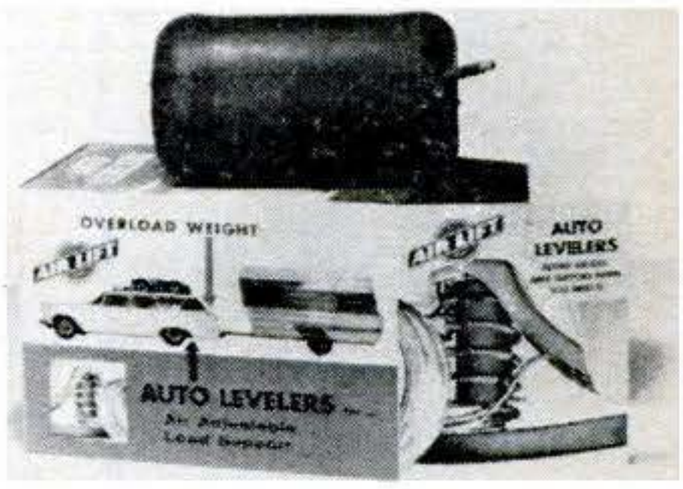

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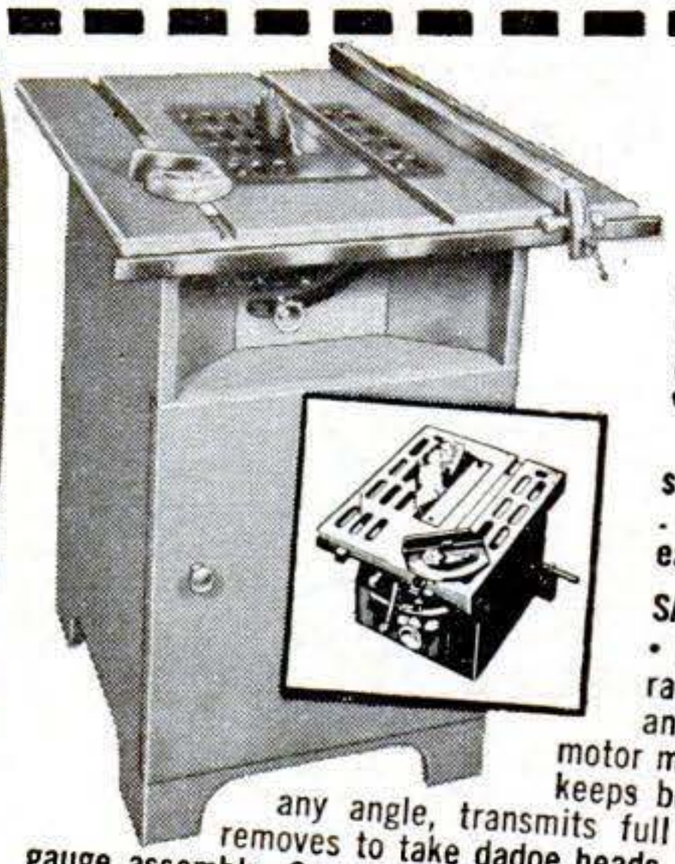

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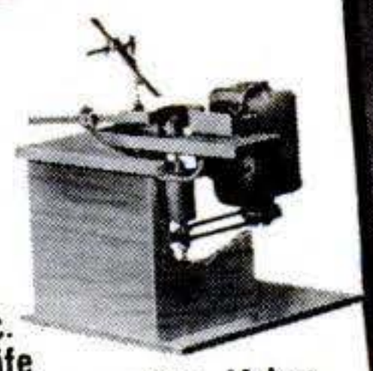

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